Heating and Ventilating

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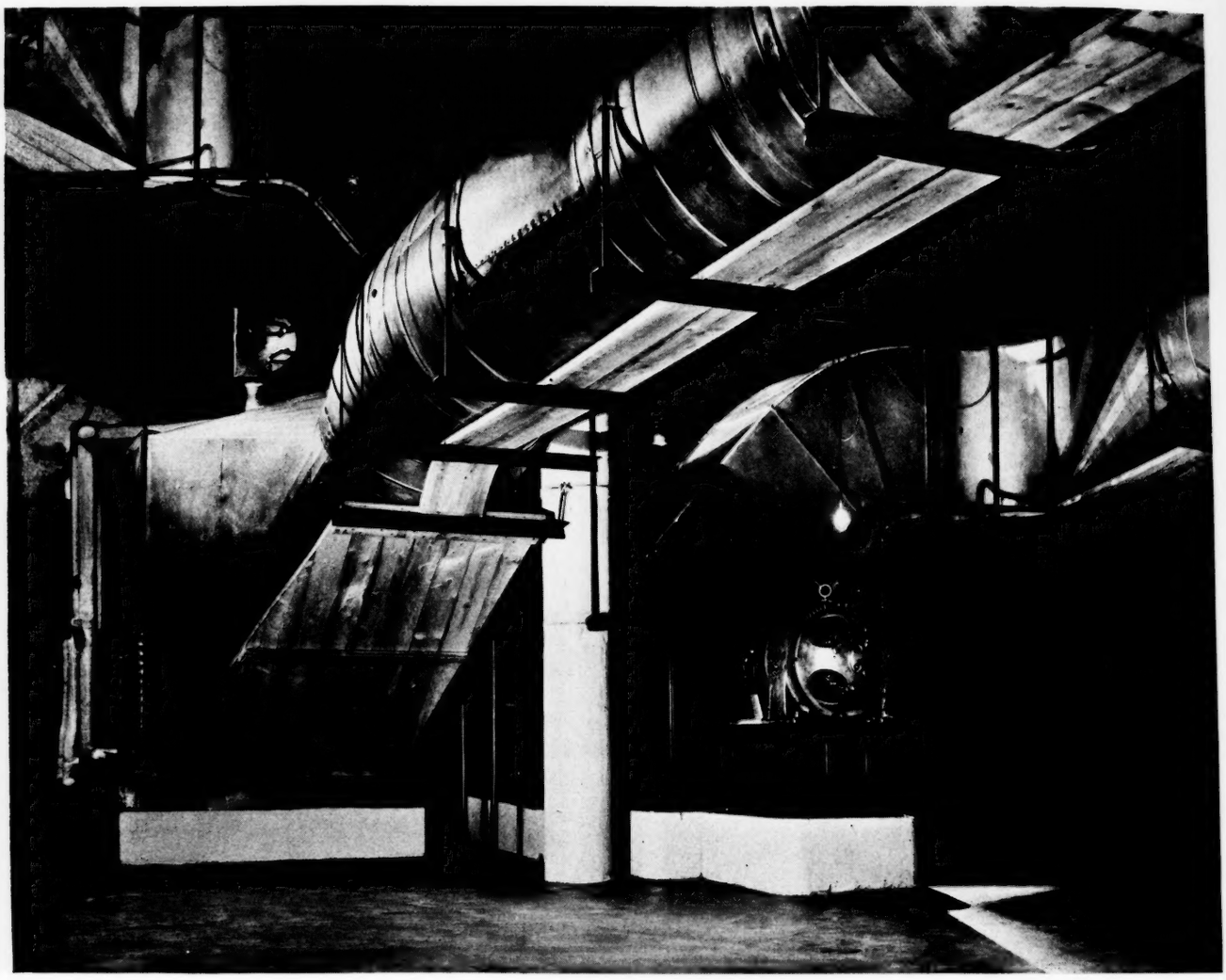
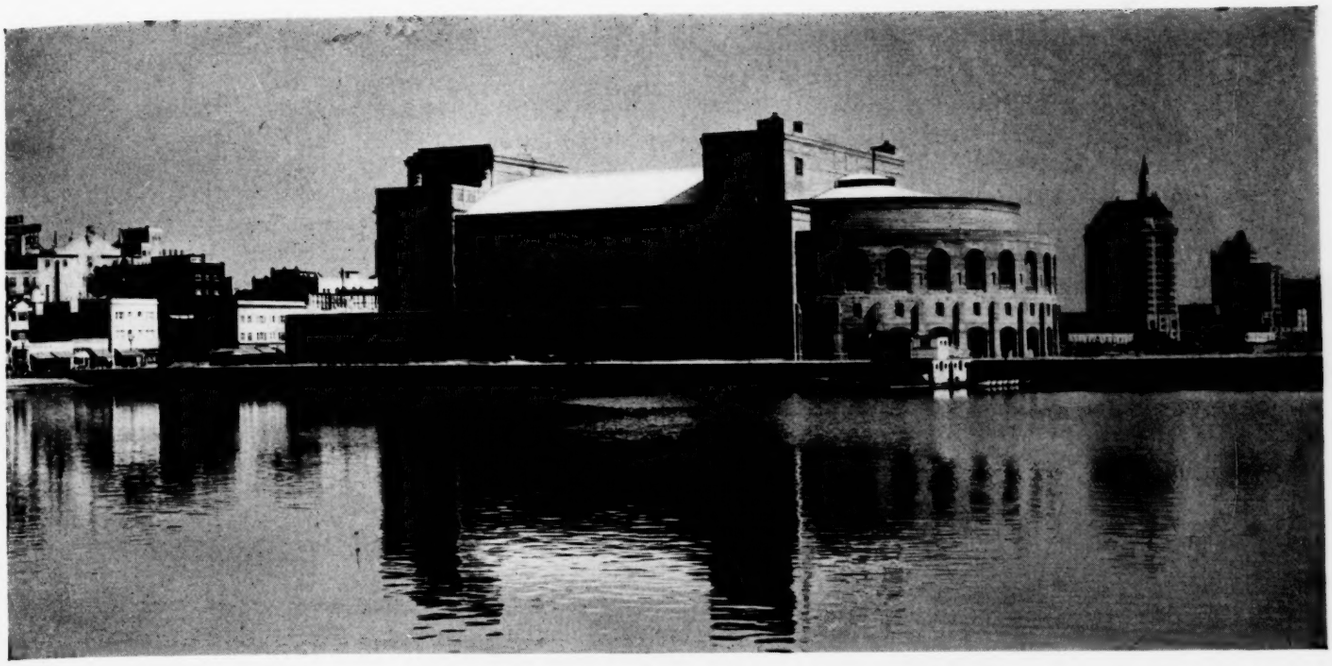


" . . . mechanical contrivances have become an integral part of the structural fabric . . . There is more beauty in a smooth surface than in rough textures produced in imitation of a generation less skilled in mechanical processes."



Architect, J. Harold McDowell *Associate Architect, W. Horace Austin* *Mechanical Engineer, Herbert Bishop Addington*

The $1,400,000 Municipal Auditorium, Long Beach, California

Mechanical Equipment of the Long Beach Auditorium

By HERBERT BISHOP ADDINGTON†

A description of the ventilation, heating and special equipment in the new Municipal Auditorium, designed for a convention hall, in one of California's most charming seaports.

THE beautiful city of Long Beach, California, 24 miles south of the center of Los Angeles on the shore of the Pacific, completed a modern Municipal Auditorium early in March. Long Beach derives its name from its miles of ocean frontage, extending eastward from its junction with Los Angeles in their common great seaport to the point where the coast swings again toward the south. About the point where the north-south axis of the city intersects the shore line, the city has built a semi-circular breakwater on a thousand foot radius, topped by a scenic drive and enclosing a strand and still-water lagoon of more than 24 acres. From the center of the semi-circle a rectangular fill of eight acres has been made and upon this stands the new auditorium. The reputation of the City of Long Beach as a summer and winter resort, its growing industrial and commercial importance to the far southwest, and the setting of its auditorium are expected to attract national and regional conventions to the city.

Arrangement of the Building

The building is approximately 179 ft. wide, 390 ft. long, and 110 ft. high in maximum dimensions, and has a gross cubage of about 4,000,000 cu. ft. Of two main levels, the lower is at grade elevation and contains an exhibition space 103 ft. wide, 260 ft. long and 15 ft. clear height with a partial spectators' balcony. The upper level contains, at the north or shore end, the main auditorium seating 5500 persons. Its overall dimensions are 139 ft. x 176 ft., and the crown of its curved ceiling is approximately 54 ft. above the floor. It has a flat roof area 103 ft. x 141 ft., arranged for portable chairs and a balcony overhanging the floor by 18 ft. on three sides, equipped for fixed chairs. At the southern end of the building is a concert hall seating 1600, semi-circular in shape, with a diameter of 69 ft. Between the two is the stage and dressing-room section, 41 ft. deep, equipped with two proscenium openings closed by fire- and sound-proof curtains.

The exhibition space is designed for use in the display of industrial, commercial, and agricultural exhibits; for athletic sports and contests; and for physical recreation.

The main auditorium is intended to be used as additional exhibition space, as well as for conventions, theatrical and other stage productions.

The concert hall is provided for smaller recitals and lectures such as will draw smaller local attendance.

†Consulting Engineer, Los Angeles, Calif.

Special Services for Exhibitions

Since a modern municipal auditorium must be prepared to house a multiplicity of diverse functions, a thorough study was made of the probable usages of this particular building in order to equip it as completely as was economically feasible. A complete prospectus of future business was prepared, based upon the records of other auditoria and modified by known conditions peculiar to the locality. One of the most important—and the most profitable—functions of such a building is the housing of exhibits. The effectiveness of many exhibits is enhanced if the apparatus can be shown in operation. Special services were provided, therefore, to make operation possible. The services provided were restricted to those which were the more necessary or profitable.

At each of six service stations provided under traps in the main auditorium floor, and at ten others about the periphery of the exhibition space, the following special services were installed:

(a) Three phase, 208 volt power for 20 hp. motors
(b) Single phase, 120 volt, 15 amp. power
(c) Telephone terminal
(d) Hot water, ¾ in. line.
(e) Cold water, ¾ in. line
(f) Gas supply of about 75 cu. ft. per hr.
(g) Waste connection
(h) Steam supply of about 300 lb. per hr. at 90 lb. gauge pressure
(i) Steam return
(j) Supply of air, about 25 c.f.m. free air compressed to 90 lb. gauge
(k) System of piping terminated in boiler room.

Since experience has shown that any one service is not required at all pockets simultaneously, the trunk lines in the above systems were scaled down by a suitable plant factor. For the high pressure system supply a vertical fire-tube boiler was provided of 80 hp. rating and a return pump was installed. The air compressor has a capacity of 100 cu. ft. of free air to 100 lb. gauge. The special service system with free end will be used as needed for many purposes, viz., higher air pressures, vacuums, special gases, vapor vent, and others.

Heating and Cooling

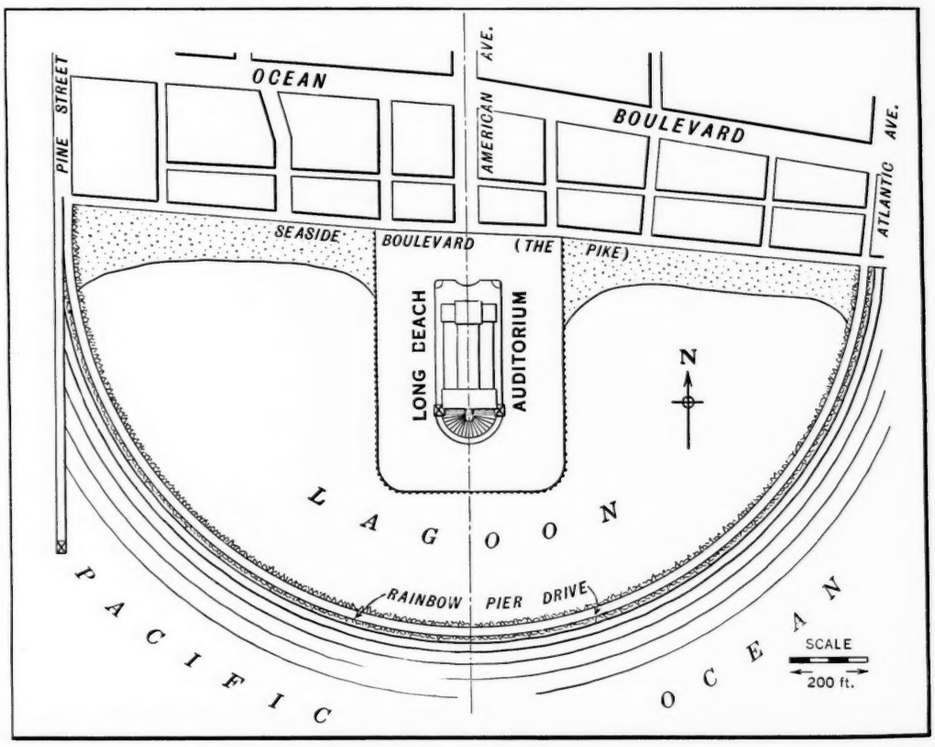
The Annual Meteorological Summary of the Los Angeles office of the United States Weather Bureau discloses the following key weather conditions (for fifty years):

Highest temperature	109°
Average days per year above 100°	1
Average days per year above 90°	13
Average days per year below 40°	17
Average days per year below 32°	0.6
Lowest temperature	28°
Maximum average relative humidity at noon	60%

Interpolations using mean temperatures and relative humidities indicated a maximum dewpoint of 63°, which was further confirmed by opinions from the meteorological office. The rapid increase in relative humidity at 5 p.m. during the winter months indicated an abrupt drop in temperature at sunset which was further indicated by the low mean minima. An almost complete lack of rainfall was shown for the months of June, July, August, and September, and very little for May and October. The above points demonstrated that the moisture content of the air was extremely low in the warmer months of the year.

The consensus of local opinion was that the maximum dry-bulb temperatures at Long Beach were 10° to 15° lower than those in Los Angeles, and that the mean minima were lower, but the extreme minima were, if anything, higher. Moisture content would be about the same except at night. These considerations indicated a differential of 40° between inside and outside temperature for heating.

The fact that the main auditorium and the exhibition space were practically surrounded by heated areas, made the heating of these rooms by tempering the air for ventilation most applicable, avoiding as well the

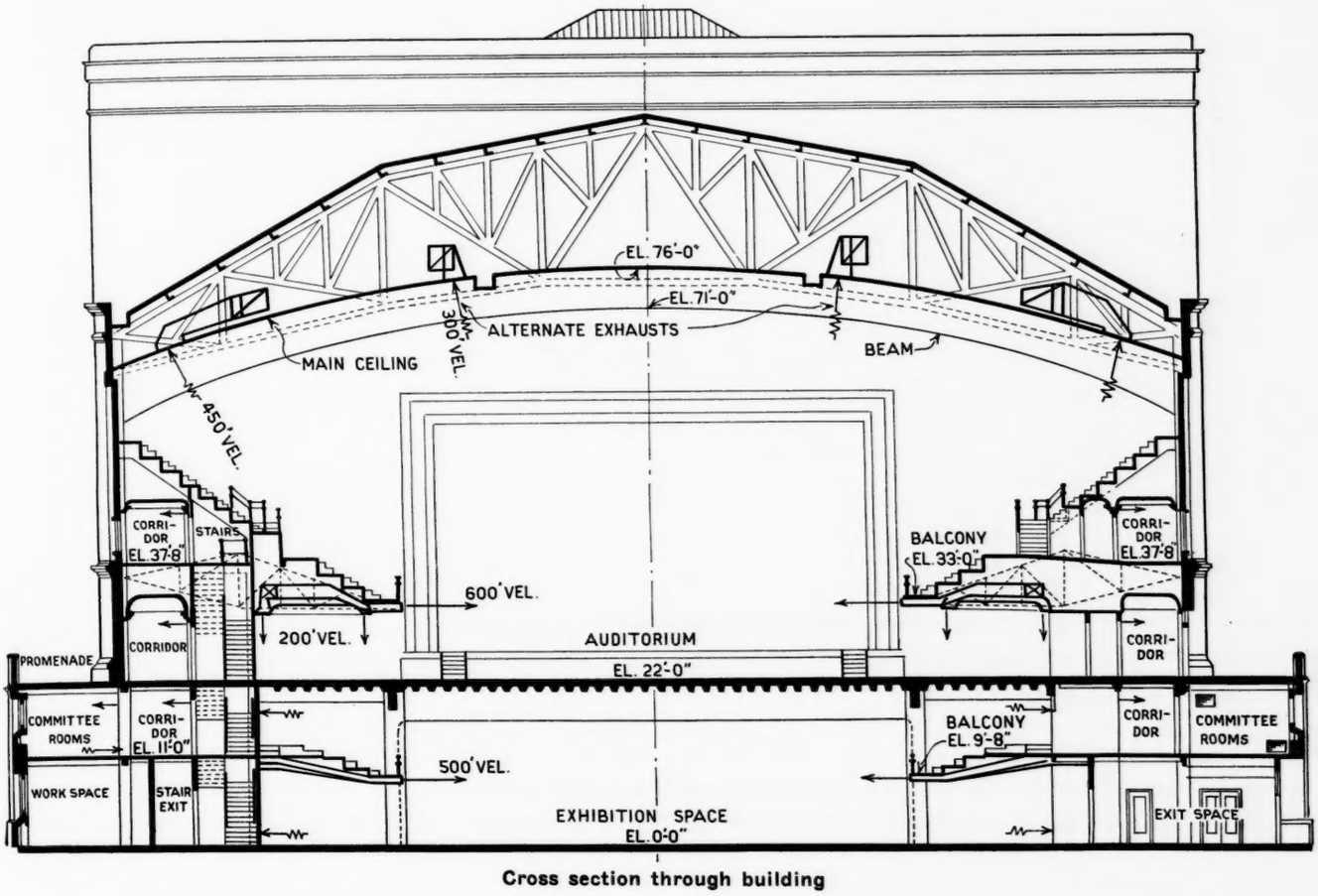


Plot plan of the auditorium and surrounding topography.

necessity for radiation in the room and obtaining greater flexibility. The smaller offices and corridors could be readily heated by air at less than 80° and it was the more economical to do so, since nearly all of these will be simultaneously in use or out of use. Certain rooms, such as permanent offices and dressing rooms, were provided with radiation in addition to air supply as exceptions to the above rule. The architectural treatment of the concert hall prevented the use of radiators, and it was designed to be heated by air.

To have installed air washers would have made necessary a great increase in structural members and an increase of building dimensions to make room for the equipment, adding so materially to the overall cost of the building that it was necessary to abandon the idea, especially in view of the small average reduction of only 3° of effective temperature.

Dry-type sectional air filters were originally to have been provided, but they were subsequently cancelled in an effort to find money for a different purpose. It



Cross section through building

The question of cooling the building had to be considered in view of limited funds—the budget allowance was 3½ cents per cu. ft. or a total of $140,000. Since hot days are caused in this locality exclusively by winds from the desert, they are invariably very dry. It was deemed more than safe to conclude 90° dry bulb and 63° dewpoint as the worst possible condition. The following table gives comparative data:

Outdoors, 2¼ m.p.h. wind, 90° dry, 75½° effective
Uncooled air, 90° dry, 77° to 79° effective
Washed air, 73° dry, 71½° to 78½° effective
Refrigerated air, 68° dry, 65° to 72° effective
(The rise in room temperature is due to absorption of heat and the effective temperature is from the scale derived by Houghten and others.)

Several factors were also considered. The clothing usually worn in this climate, especially by visitors, is lighter than "normally clothed" as used in deriving the effective temperature tables. Natives are acclimated to demand a comfort zone higher on the temperature scale. It was deemed unnecessary to include refrigeration in view of these conditions.

is regrettable that this step was taken because for several days out of each year a sand storm of fine dust sweeps down from the desert, the long dry summers fill the air with the powdery dust of dry 'dobe, and smudge from the citrus sections form low clouds on the rare visitations of frost. The damage done to decorations, drapes and furnishings, and the resultant cost of cleaning and renovating will exceed the fixed and operating costs of the filters by a wide margin.

Ventilating System

In several instances the architectural and structural design of the main auditorium was modified to permit the most efficient control of ventilation possible. A controlled and uniform current of air of considerable intensity over the occupied area was desired for its cooling effect, and at the same time an absence of draft when heating. To this end the system was made reversible. During hot weather half the air is introduced through the facia of the balcony—10 ft. from the floor

—at approximately 600 f.p.m. velocity. The remainder is admitted from the the soffit of the balcony overhang, directed downward at 200 ft. or less. It is intended that the fast-flowing sheet of air, by induction and by forming a blanket through which the air below cannot rise, shall draw the other half supply across the living zone at about 60 f.p.m. to the center of the room before it can escape upward. The exhaust grilles are located in the curved ceiling, facing almost the slope of the balcony and uniformly distributed around the periphery of the room. The action of these grilles is to draw the entire volume of air over the balcony zone of occupation.

Additional grilles are provided near the center of the ceiling and connected through dampers to the same duct system as the other ceiling grilles. These grilles will be used under such conditions as arise from exhibitions during which few people are in the balcony and there is an unusual production of heat or fumes from the floor area.

For heating conditions the same cycle of flow might be used as for cooling, the draft being the only undesirable feature and detrimental only in extreme conditions; or the system may be reversed, using both sets of ceiling grilles for supply. In the latter case no noticeable draft will result.

In the exhibition space the air is all supplied through the balcony facia (or the walls where the balcony is discontinued) at high velocity, and the major portion is exhausted at floor level along the walls. Sufficient exhaust is provided above the balcony completely to ventilate that portion. This system is not reversible.

The concert hall is ventilated by its own supply and exhaust system, arranged to be reversible, with one set of grilles near the ceiling and the other near the floor, both distributed about the periphery of the room. Since this room has exterior walls and considerable glass area, it was decided to supply heated air at the top on account of the high initial temperature, and draw it down to the living zone. Conversely, the warmer air is to be drawn off the ceiling during hot weather by reversing the system.

All corridors and entrance or exit foyers are supplied with sufficient quantities of air to form a positive plenum, reducing the infiltration of outer air to the main auditorium and exhibition space to a minimum. The small rooms along the outer walls of the building are ventilated in the usual manner, the amounts of air being determined by the estimated heat loss of each room.

The main auditorium system consists of duplicate units, as also does the exhibition space system due mostly to space limitations. The concert hall has an individual system and the same is true of the stage and dressing-room section. The fans are driven through V-belts by polyphase motors, most of which are variable speed. The air heaters are fin-and-tube type, two-row, with each section under separate automatic control, and all have by-passes. General and stage supply temperatures are controlled by manually adjustable duct thermostats and the others by room or exhaust duct thermostats. All shut-off dampers are pneumatically operated and all reversing dampers are controlled from the engineer's office by the pneumatic system.

Naturally, quietness of operation is an important factor in a building of this character. Noises in ventilating systems usually are due to

(a) loose dampers and unsupported projections into the air stream,

(b) shaking of the ducts and the bellows action of the ducts under turbulent flow, and

(c) turbulence in the air flow.

Proper design of small details and good workmanship eliminate the first of these, and special care must be taken in this respect where high velocities are used. Rigid support and bracing of the ducts, separation from contact with other objects, flexible connections to the fans, and the use of heavy gauge metal in the ducts to reduce the deflection of the sheets under the alternating interior pressure, are to be used to lessen the troubles under the second item. Bends should also be given the greatest possible outside radius and dampers should be placed in sections where the natural flow is as straight as possible.

Turbulence of flow is caused by the eddies and negative pressure areas, especially on the downstream side of obstructions and splitters, on the inside curve of bends, and around orifices and nozzles where changes of velocity occur. It has been the writer's observation that, in general, turbulence is small at very slow velocities and decreases again at high velocities. The area of the duct, however, has a pronounced effect upon the amount of turbulence at a given velocity. In this installation, velocities of 2000 f.p.m. were used between fan and atmosphere and 1500 f.p.m. in the main trunks, tapering off to 400 to 800 f.p.m. in the branches.

So-called fan noise rarely occurs in a properly-chosen fan since reliable manufacturers build the blades and housings to eliminate turbulence as completely as possible at the most efficient point of operation. Noise is more often caused by obstruction at the fan inlet or poorly-shaped discharge nozzles, which should have a long taper. In this installation, pains were taken to make the sweep of elbows as gentle as possible, orifices were avoided where the velocities were high, and all changes of velocity were accomplished by means of long-taper fittings. Velocity heads at grilles were freely used, both in order to distribute the air uniformly over the grilles and because the pocket, if of correct proportions, forms good acoustical insulation.

The installation when tested with the building completely empty and silent gave quite satisfactory results. The auditorium and the concert hall systems were almost inaudible to listening ears at full speed and the other units were within requirements.

The Frontispiece

The ductwork and air conditioning apparatus shown on page 18 are parts of the air conditioning system—one of the largest in the world—in the plant of the Eastman Kodak Co., Rochester, N. Y. The photograph is by H.L.Irwin, and is reproduced through the courtesy of "Applied Photography," published by the Eastman Kodak Company.

Steam Plant

To furnish steam for heating and tempering the large volume of air, two 260 hp. boilers of the horizontal water-tube type were installed. The combined capacity of these boilers is a trifle below the total connected load. Since it will rarely happen that the entire load of the building will be in demand at any time and, except when one boiler may be out of service, the overload capacity of the plant can easily carry the excess, greater capacity is unnecessary and the inefficiency due to a large boiler carrying a small load is lessened. Boilers will operate at present at 3 to 5 lb. ga., but they are good for 100 lb. ga. and it is possible that they can be increased to 35 lb. ga. with a few minor changes and the installation of feed pumps. Natural gas is used for fuel as the most economical under local conditions and the burners are designed for 25% continuous overload or more.

Vacuum return pumps in duplicate of ample capacity have been installed and return direct to the boilers. The steam mains, being large and generally straight, have been made small for economy but with due regard to flow noise. The return lines were made of ample size to prevent water hammer.

Conclusion

The mechanical equipment of this building was not designed to be the last word in mechanical perfection, but rather to obtain the maximum value of utility and comfort for the money spent. Indications thus far point to success in this endeavor.

Concealed Unit Heaters Heat Pumping Station

A NEW use is made of unit heaters in the heating system of the Springwells Pumping Station of the Public Water Works, Detroit, Mich. Forced air heaters, concealed in cabinets built into the walls, heat the huge main pump room. There are 40 units in all: thirty-four 1500 c.f.m. units in the side walls, two 3000 c.f.m. units at one end of the building, and four 5000 c.f.m. units at the other end.

The pump room occupies an entire building 400 ft. x 108 ft. with a 60 ft. ceiling. The volume of the building is more than 26,000,000 cu. ft. when the nine large pump pits are taken into account. A door large enough to accommodate a switch engine at one end of the building is the only opening of any size in the structure.

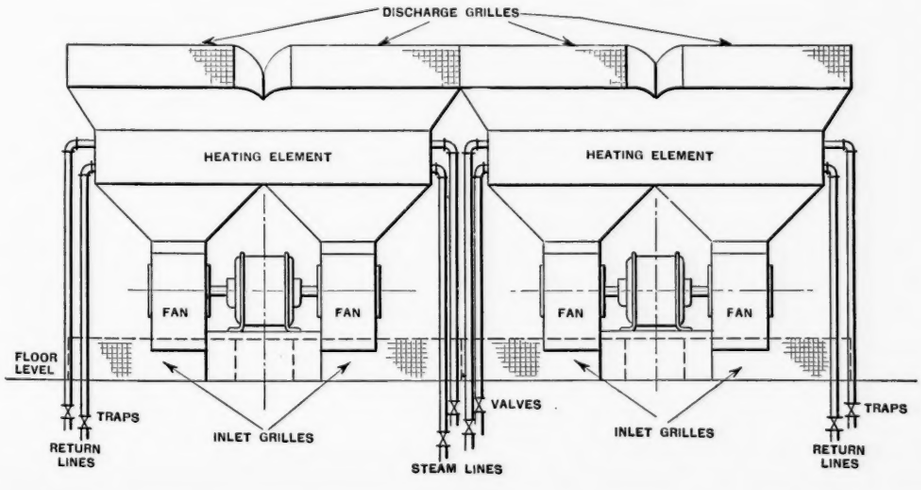
The heaters consist of a double-shafted motor with a double inlet centrifugal fan mounted on each shaft. The fans draw air through inlet grilles at the floor line and force it through copper-fin radiators directly above. The air is discharged through grilles set at a 45° angle with the wall and directly under the window sills, approximately 6 ft. above the floor. The heaters are used to recirculate entirely. The units are thermostatically controlled. The thermostat acts on the temperature of the inlet air and regulates the steam flow through the heaters, the fans operating continuously.

On completion of the project, steam for the heaters will be bled from a turbine. The steam is supplied in three distinct systems. The 1500 and 3000 c.f.m. units are grouped on one system, the 5000 c.f.m. units account for another, while the third supplies the direct radiation in the piping galleries and pump pits.

All steam and drip lines are copper, ranging from 4 in. diameter to 1 in. diameter. The smaller sized pipes are equipped with threaded fittings, while the larger sizes have faced flanges, the gaskets being cut accurately to the inside diameter of the pipe.

When first operated, the noise from the units was objectionable. The noise was eliminated when the motor voltage was corrected, investigation having revealed that it was only one-half nameplate reading.

—James J. Murray



Elevation of Unit Heaters.

Industrial Air Conditioning†

By GEORGE B. BAILEY‡

AIR conditioning in the broader sense may be defined as the changing of the state of air for a definite purpose. More often it refers to a thermal change in the state of the air; i.e., the addition or subtraction of heat and water vapor. Air cleaning can also be included although it is distinctly a mechanical operation, but this discussion will have more to do with the factors heating, cooling, humidifying, and dehumidifying.

Requirements for air conditioning in the industrial field may be divided into two classes; i.e., comfort requirements and process requirements. Undoubtedly these two should be considered of equal importance, but very often the process requirements are such that the cost of obtaining the comfort condition along with the required process condition would be prohibitive. Therefore, the average industrial air conditioning problem resolves itself into one of obtaining most efficiently the desired process condition along with as much of a comfort condition as is possible, in accordance with a justifiable capital, operating, and maintenance expenditure.

Heating, perhaps, was the first form of air conditioning; certainly in those climates where the temperatures drop far below the comfort zone. However, in this discussion we will limit ourselves to the consideration of those problems where one or two of the other factors of air conditioning are necessitated along with heating.

Most materials react to changes in the temperature and hygroscopic condition of the air, and when this reaction is such as to interfere with production in a manufacturing process, air conditioning becomes necessary. The problem will vary in its degree of complication from a simple application of humidity to offset the intense dryness of winter months to the more involved problem of maintaining a constant temperature and humidity the year round. However, even the latter extreme problem is not so complicated, although it is often made so unnecessarily.

Process air conditioning problems may be generally grouped as follows, in about the order of their degree of complicity:

(A) Moderate humidity above a minimum required. Temperature to be maintained above a minimum.
(B) High humidity required. Temperature to be maintained above a minimum.
(C) Low humidity required. Temperature to be maintained at a constant or operating between a maximum and a minimum.
(D) Constant temperature and humidity required.

To increase the humidity or decrease the hygroscopic condition of the air to meet the requirements of problem A, water vapor must be added to the air. The least expensive method of getting water into air to satisfy these requirements is by means of a steam jet. It can also be accomplished by mechanical atomization, air atomization, or with a standard air washer. These methods have been named in about the order of their relative cost.

In Fig. 1 is shown a very simple but effective method of applying the steam jet for humidifying along with the unit heater. The unit heater is a flexible and advantageous piece of equipment, due to the fact that it not only supplies heat but very effectively distributes it. Distribution in any air conditioning problem is an important factor. The arrangement shown in Fig. 1 will not only result in a uniform but also a constant temperature and humidity, due to the automatic control of steam to both the unit and jet.

Problem B is slightly more involved than A, inasmuch as the high humidity requirements necessitate the introduction of humidity in the summer time as well as in the winter. Such a problem faces the average textile manufacturer who desires to maintain humidities of 60%-65% at about a temperature of 75°. We find that the steam jet can also be applied here but should be limited to winter use only. In years gone by it was customary to introduce steam the year round for this purpose but, unfortunately, steam in itself not only supplies the heat of vaporization but the additional heat of the liquid, which resulted in a very uncomfortable summer condition. The additional heat of the steam jet is entirely acceptable in the winter time and helps offset the normal heat losses but, obviously, what is an advantage in the winter time becomes a disadvantage in the summer time.

Therefore, other methods of humidification were introduced which have a cooling effect when humidifying, due to the absorption of the heat of vaporization from the air. This, of course, is an advantage in the summer time and resulted in the discarding of the steam jet. Most of the later textile installations have been of the mechanical or air atomization type, although the air washer has been used to some extent.

On the other hand, it might be well to call attention to the fact that although mechanical or air atomization is an advantage in the summer time, due to the cooling effect, it is for the same reason a disadvantage in the winter time. Enough additional radiation must be installed in the room being humidified not only to offset the normal heat losses but also to take care of the heat absorbed by evaporation. For this reason it is often necessary to install additional radiation along with a new mechanical or air atomization system of humidification.

†Abstracted from a paper presented at the Process Meeting, American Society of Mechanical Engineers, Buffalo, June 7.
‡President, Thermal Engineering Co., Boston.

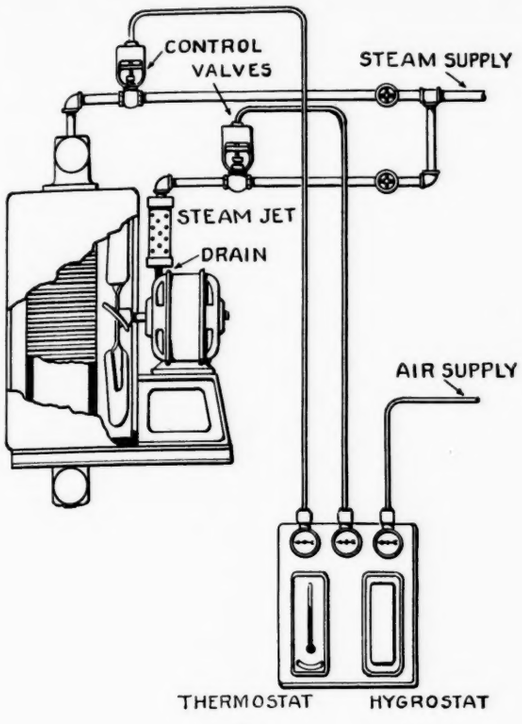


Fig. 1

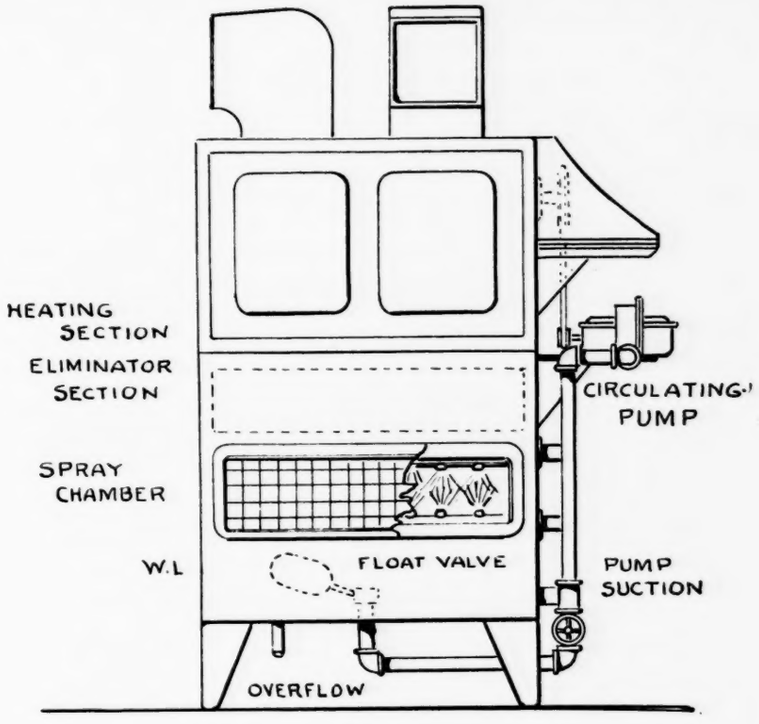


Fig. 2

From the foregoing it is obvious that a system involving the supplementing of an air atomization humidifying system by the steam jet would result in several advantages. Not only would it eliminate the necessity of additional radiating surface to supply the heat of vaporization, but a very considerable saving is effected, inasmuch as the number of atomizing heads would be greatly reduced with an accompanying reduction in operating expense. Of course, provisions can be made for heating the water delivered to the atomizer heads which will have somewhat the same effect as humidifying directly with steam.

The unit air washer and heater shown in Fig. 2 may be applied very satisfactorily and economically to the problem which we have just been discussing. Although the air washer will cool by evaporation in the summer time, by adding heat to the water in the winter time with a steam ejector or indirect heater, the heat of vaporization may be supplied to the water, greatly increasing its humidifying capacity. When the water in an air washer is not heated it assumes a temperature corresponding to the wet bulb temperature of the air in the room, the air leaving the unit being saturated at the wet bulb temperature. However, it can readily be seen that as soon as heat is introduced to the water, not only can the cooling effect be offset but the water can be heated up to a comparatively high temperature, with the result that the moisture-carrying capacity of the air circulated through the washer is greatly increased. In this way a comparatively small unit can be used to handle a very large room.

Another distinct advantage of the air washer unit is large volume air circulation resulting in more uniform distribution. One of the disadvantages of the air or centrifugal atomizer is that it gives a localized condition of excessive humidity, which will result in condensation on water pipes, machinery, etc., immediately adjacent to the heads, unless extreme care is taken as to their location. On the other hand, the air discharged from the unit air washer, although it may be highly saturated, quickly mixes with the surrounding air, thus preventing this condition.

Passing on to problem C which confronts the confectionery and gum manufacturer, machine testing laboratory, low temperature and extreme drying operations, etc., we find that cooling and dehumidification are required along with heating. These applications do not require a constant relative humidity but necessitate the prevention of the humidity getting to a point where condensation on or absorption by the materials would take place. In some of these applications (for instance in the machine testing laboratory) a perfectly constant temperature is required. However, in others operation between a minimum and a maximum is allowable, in which case it is obvious that the system should operate at the minimum temperature in the winter time to reduce the heat losses to the outside atmosphere, and vice versa at the maximum temperature in the summer time, to reduce the amount of refrigeration necessary.

The heating is accomplished either with ordinary direct radiation or through unit heaters, and the cooling and dehumidification through the unit cooler and air washer. If desired, the heating and cooling can be combined in a single unit as, for instance, the unit heater and cooler shown in Fig. 3. If there is an adequate supply of cold water this may be used for cooling and dehumidification by application through an air washer but, as a rule, it is necessary to go to some kind of refrigeration.

Dehumidification can also be accomplished by passing air over or through absorbent materials having a high affinity for water vapor such as silica gel, calcium chloride, sulphuric acid, etc. This method can be used to advantage on extremely low humidity drying problems where the cost of refrigeration, to get a desired low dew-point, would be prohibitive. It can also be

used directly on other problems which do not involve the limiting of temperature.

The last group to be considered is that in which all four thermal changes of the air must be controlled. The specification for group D is for a constant humidity or hygroscopic condition and either a constant temperature or a temperature to vary between a minimum and a maximum. More often a constant hygroscopic condition is really the important factor and the temperature can be allowed to fluctuate considerably between a minimum and a maximum. Maintenance of a constant temperature unnecessarily will quite often result in a greatly increased first cost and operating cost. For instance, the first cost and operating cost of the refrigerating system required to maintain a constant temperature of 72° and a relative humidity of 50% may be double that necessary to maintain 80° and a hygroscopic condition equivalent to 72° temperature and 50% relative humidity.

The printer, lithographer, paper products manufacturer, paper testing laboratory, rayon manufacturer, etc., all come under this group. A constant hygroscopic condition or equilibrium is what they are interested in rather than constant temperatures, inasmuch as these products react but slightly to a change in temperature but very considerably to a change in hygroscopic condition of the air.

Problem D then requires much the same equipment as problem C, except that humidity must be added to maintain a constant hygroscopic condition. The unit heater and cooler along with control of steam jet as shown in Fig. 3 is one of the simplest arrangements. It will be noted that there are two thermostats and one hygrostat on the control panel instead of the single thermostat shown in Fig. 1. When properly connected, such an arrangement will automatically maintain a constant hygroscopic condition between the minimum and maximum setting of the two thermostats; i.e., the minimum in the winter months and maximum in the summer months, resulting in a very considerable saving of both heat in the winter and refrigeration in the summer.

Of course, the steam jet in Fig. 3 can be replaced by an air or mechanical atomizer. Further, the air washer unit can be used to advantage in many instances, in which case the sprays should be used for cooling and dehumidifying or for humidifying.

If the air washer is improperly applied on a problem involving humidification as well as cooling and dehumidifying, it may become a very inefficient piece of equipment. A common application, which will lead directly to unnecessary waste of heat and refrigeration, is the operation of the recirculated air washer unit as in Fig. 2, by a built-in dewpoint control. This involves the use of a thermostatic bulb placed in the air stream as it leaves the eliminator plates controlling the water from refrigeration source. This results in a constant dewpoint of the air leaving the unit. Therefore, if enough fresh air to offset the normal room leakage is introduced through the unit and the air volume recirculated is large enough, the dewpoint in the room being conditioned will be practically constant. The temperature is usually controlled by a thermostat placed in the room, which controls steam to the heating coil to offset cooling in the spray chamber when necessary. With such an arrangement, the refrigerating load is practically a constant. In other words, in spite of the fact that on some days there will be perfect equilibrium between outside and inside conditions, requiring no addition or subtraction of heat, such equipment will go through about the same motions as on those days when maximum cooling and dehumidifying are required. Suprising as it may seem, there are many large installations operating on this basis today, causing the waste of many thousands of dollars in power and steam.

The observations in the foregoing paragraph and other references to the unit air washer apply also to the central type of air conditioning system. It might be mentioned here that both the central system air washer and unit air washer have an advantage of doing a certain amount of air cleaning. However, it is recognized that where any real problem of air cleaning exists, an application of an oil or viscous filter should be made.

The refrigerating system is a very important part of the more complicated air conditioning system. It has been common practice in the past to apply mechanical refrigeration either directly or indirectly. If the unit cooler is used, direct expansion of the refrigerant in the cooling coil, as shown in Fig. 3, is perhaps the best method. On the other hand, if an air washer unit is used for cooling and dehumidifying, the refrigerant is expanded into a water cooler. Of course, wherever available, a source of 50°-55° well water can be used advantageously.

A comparatively new development in refrigeration, which is of interest to all engineers, is the steam jet refrigerating unit shown in Fig. 4. This equipment not only presents a very interesting thermal cycle, but wherever steam at 100 lb. or more pressure is available, it bids fair to eliminate consideration of other types of refrigerating equipment, on problems involving the cooling of water down to 40°, because of its low first cost, operating cost, and compactness. By actual comparison on one problem involving 75 tons of refrigeration, the first cost of the equipment of the steam jet refrigeration equipment was approximately 40% less than the mechanical equipment, with operating cost of $1.50 per hr. as against $3.50 per hr. Of course, this

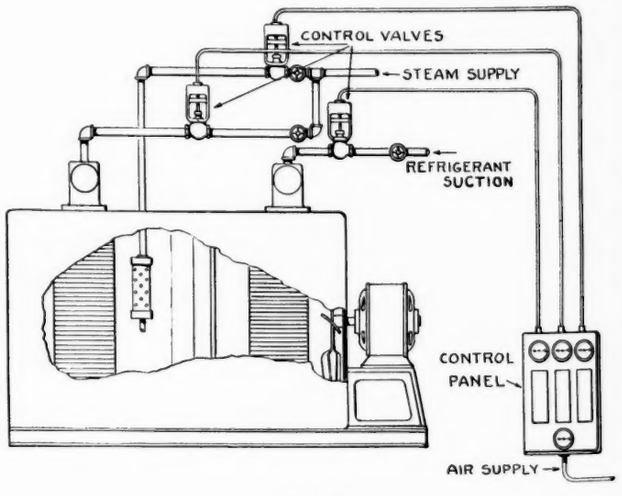


Fig. 3

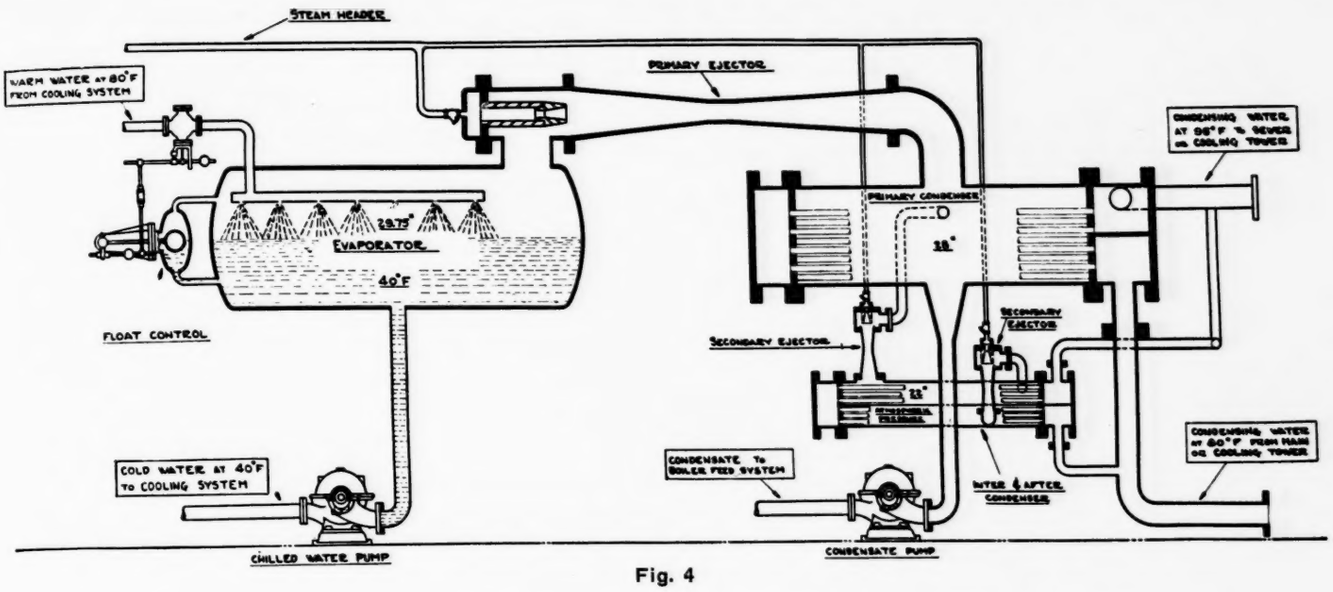


Fig. 4

was in part due to the fact that by using a barometric condenser it was possible to make use of an available but very dirty water supply for condensing purposes, whereas it would have been necessary to purchase city water for condensing purposes on a mechanical refrigeration unit. This equipment should be of special interest to all central steam plant and industrial engineers.

In concluding, the importance of automatic control in air conditioning should be emphasized. A poorly controlled system will most assuredly result in high operating cost, as already discussed. On the other hand, properly applied automatic control will result in maximum efficient production coupled with minimum heat and power expenditure.

Air Conditioning for the Contractor

THE heating contractor is confronted with the fact that cooling, artificially accomplished, usually requires an electrically-driven compressor, and that the efficiency is really a function of the electric motor which, as everybody knows, has a very low basic efficiency when compared to the development of steam by means of the combustion of oil, gas, or coal. In fact, it is practically the same thing but in the opposite direction of heating a house electrically. In other words, it really is cooling a house electrically, except for the amount of cooling effect which is obtained from the condensing of water.

Then the heating contractor must take into consideration that air conditioning, particularly cooling and dehumidification, is a new art, and that a good many of the basic methods used today for accomplishing, economically, the cooling required, are still covered by rather strong patents. It can be stated, however, as a guide to the heating contractor, that if he can figure his heat losses or his heat gains in the summer time, he can approximate the number of tons of refrigeration that it would require to cool, by dividing his heat gain per hour in B.t.u. by 12,000.

I mention this because one of the first considerations of his prospective customer will be how much refrigeration would be required to cool an isolated room, or a house, or any section of the house. If the heating contractor will then figure that about 1½ hp. is required to develop a ton of refrigeration electrically, and that it takes anywhere from 120 gal. to 300 gal. of water an hour to condense the refrigerant when developing the ton of refrigeration, he will be in a position to answer the inquiries of his prospective customers.

Practically all of the manufacturers of domestic refrigerators are or will be in the field to provide machines for household cooling, and whether the contractor obtains the proper size for his future installation will depend to a certain extent on the honesty of the refrigerating manufacturer and partially on his own rule-of-thumb knowledge of what the requirements may be. It is always well in purchasing a refrigerating machine for cooling purposes to have the manufacturer of the apparatus guarantee its output in B.t.u. per hour, rather than in tons of refrigeration. It is also well to bear in mind in cooling that the elimination of 1 lb. of water per hr. requires the extraction of 1000 B.t.u. or 1½ tons per hr., and that the extraction of the moisture from the air may give a feeling of comfort but will do no cooling, except that cooling which must occur in reducing the temperature of the air to the point where the moisture falls out, automatically lowering the temperature.—*Walter L. Fleisher, in a paper read before and copyrighted by the Heating and Piping Contractors National Association.*

Air Conditioning the Philadelphia Saving Fund Society Building

By L. S. TARLETON†

The operating, maintenance, and fixed charges on the air conditioning of this office and bank building—the largest of its type to be completely conditioned—will amount to only 15 cents per square foot of rentable area. The author discusses the final features of this system, tentatively described here some months ago.

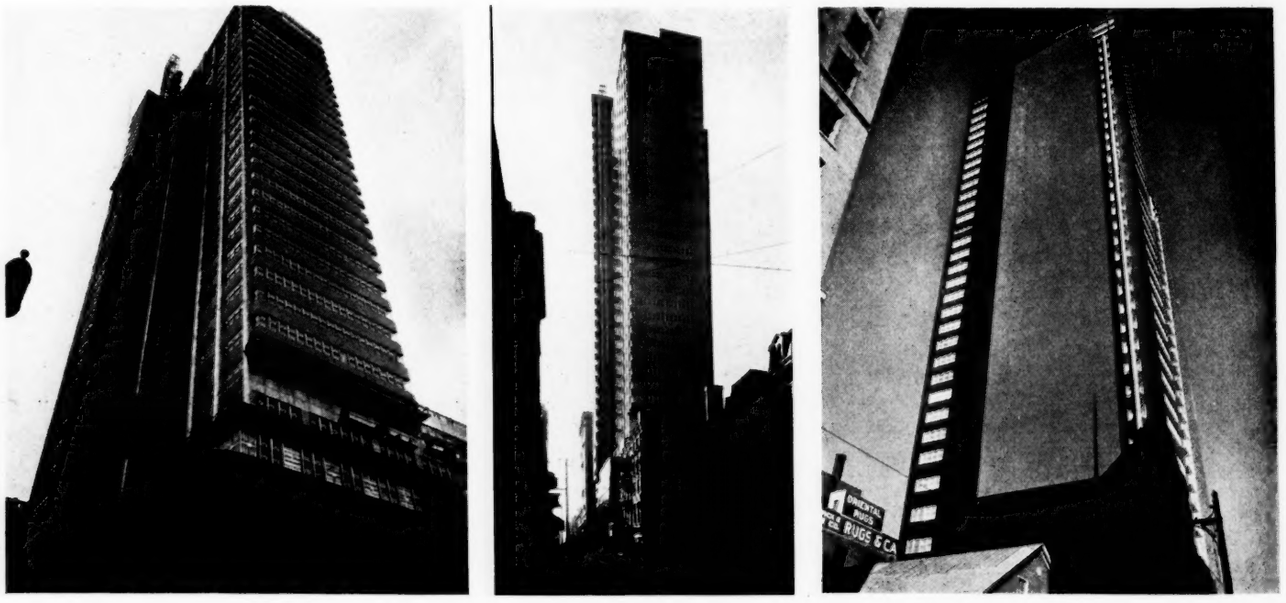
DURING the preparation of the description of the air conditioning systems for the bank and office building of The Philadelphia Saving Fund Society, which appeared in the September, 1931, issue of HEATING AND VENTILATING, the writer was conscious of a certain feeling of guilt. At that time the Society and the architects, Howe and Lescaze, had under serious consideration the conditioning of the air supplied to the entire building, and it seemed fairly certain that this project would go forward. Nevertheless, many details had to be studied in connection with this radical step, and until the problems which these details presented were solved it was requested that publicity be withheld.

It has ever been the wish of the owners that this building be an outstanding achievement in modern construction. With unusual far-sightedness, it was the feeling of the Society that the time was not far distant when air conditioning would be as vital a factor in the equipment of a modern building as are the heating or the electrical wiring systems. Furthermore, the severity of present rental competition, exaggerated by the present economic stringency, drove home the thought that complete conditioning would provide the rental agent with a powerful sales argument. Complete conditioning, therefore, was viewed as an essential, to be had if the cost would permit.

Although the writer does not feel at liberty to discuss the financial set-up which was used to determine the operating, maintenance, and depreciation cost per square foot of rentable area for conditioning, it seems somewhat surprising that the cost is as low as approximately 15 cents per square foot. It is being argued, and reasonably, that any tenant paying this amount should more than realize on his investment with better health, increased output and freedom from dust and street noises. Furthermore, notwithstanding this additional item in the make-up of the rental charges, it will be found that the actual rentals are quite in line with those charges made by neighboring competitors.

This building now becomes the largest building of its type to be fitted with equipment for complete conditioning.

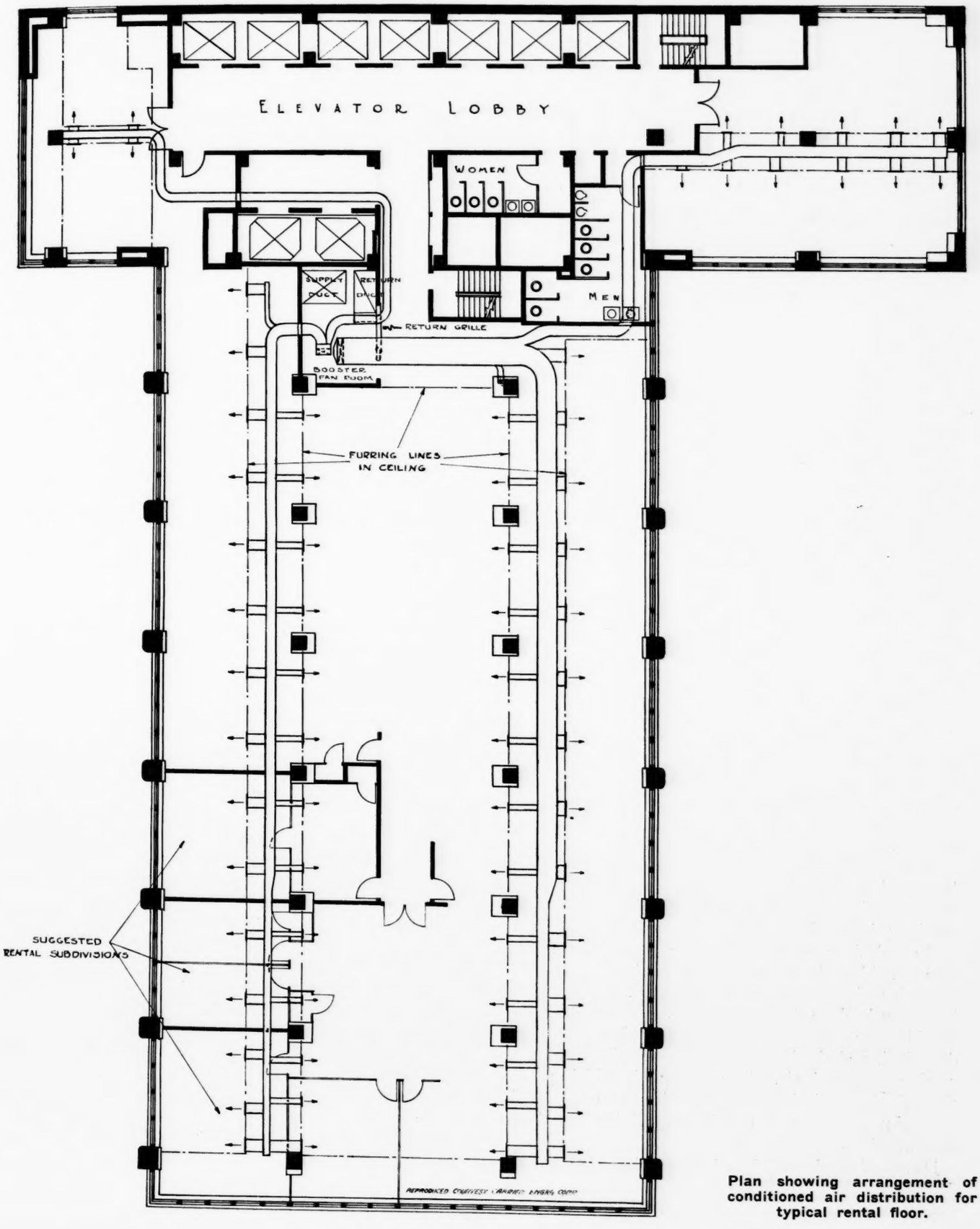
†Engineer on the staff of H. Berkeley Hackett, Consulting Engineer, Philadelphia.



Three unusual views of The Philadelphia Saving Fund Society Building

Fortunately, although the structure was under construction during the design, it was possible to plan for the supply of conditioned air to the entire building with but very minor alterations.

It was necessary to utilize approximately 150 sq. ft. of area on each floor to accommodate vertical ducts and fans. These areas have no exterior exposure and would have been inferior rental spaces. Certain additional areas on the twentieth floor, which floor had already been alloted as a machinery floor, were required



Plan showing arrangement of conditioned air distribution for typical rental floor.

for dehumidifying units. These were the two principal items requiring rearrangement of the interior of the building.

All office areas from the sixth to the thirty-first floor, inclusive, will be supplied with conditioned air, cooled and dehumidified in the summer, warmed and humidified in the winter. The twentieth floor only is excepted, but there are no rentable office areas on this floor.

Furthermore, the conditioning system outlined in the previous article for the thirty-second floor has been altered so as to be served by the typical floor system, thus eliminating the small separate conditioning unit formerly required.

Two conditioning units will be placed on the twentieth floor. The one unit will condition the air for the floors from the sixth to the nineteenth, while the other will serve the floors between the twenty-first and the thirty-second, inclusive. Each of these conditioning units is similar in make-up to the other conditioning units in the building, comprising preheaters, air filter, dehumidifier, reheater, fan and control dampers.

. . . . . **"The consequences of the industrial revolution on the architect's material world are essentially three:**

1. The machine has transformed handicraftsman into craftsman mechanic.

2. Transportation has done away with local limitations in the use of materials.

3. The steel or concrete column has replaced the masonry wall and mechanical contrivances have become an integral part of the structural fabric" . . . . . .

George Howe, of Howe and Lescaze, designers of The Philadelphia Saving Fund Society Building.

Air for both units is taken from the exterior through an opening on the east side of the building at the twentieth floor level. Vertical supply ducts will run from the twentieth floor—one down to the sixth floor—the other up to the thirty-second floor. Into these ducts, the respective fans of the conditioning units discharge saturated air. Adjacent to and paralleling these supply ducts, return ducts are provided.

On each office floor are located two small booster fans. These fans draw saturated and conditioned air from the vertical supply duct, mix it with return air to the proper degree of humidity, and distribute it to the offices on the floor. The one fan serves the areas on the eastern and northern exposures, whereas the other serves the offices on the southern and western exposures.

Horizontal ducts supplying the offices on a floor will be furred to present a false beam appearance, and air will be discharged from these ducts horizontally through specially designed outlets.

On each floor, the corridor will act as a return duct. The corridor doors are constructed with louvers, through which the return air will pass. This air will be drawn back to the booster fan room where some of it will enter the main vertical return duct previously described, and the balance will be mixed with the incoming saturated air. The return air which passes through the vertical duct will be drawn to the conditioning units, where it will be reconditioned and redistributed.

Distribution of conditioned air on the thirty-second floor is the same in principle as that of the typical floors. Separate booster fans are required for the directors' room, the dining room, the lounge and the committee room. In these areas it is necessary to carry the return air back to the main shaft in ductwork.

The two conditioning units will deliver to the main vertical shafts a total of approximately 104,000 c.f.m. Of this quantity, the maximum drawn from the outside is 48,500 c.f.m., the balance being return air from the vertical shafts. The booster fans distribute to the various floors a total of approximately 163,500 c.f.m., of which, under maximum capacity, about 35% is return air, the remaining 65% being drawn from the main supply shafts.

Two additional compressor units are required in the sub-basement to chill the water for the conditioning units on the twentieth floor. These compressors are similar to those which were described in the previous article, but each has a capacity of 286 tons of refrigeration, being driven by 400 hp. motors.

Chilled water will be circulated between the twentieth floor dehumidifiers and the sub-basement compressors through a closed system. Two circulating pumps are provided, one being a spare. Each of these pumps will be operated by a 125 hp. motor and will be capable of circulating 1970 g.p.m.

The tremendous additional load on the water mains, brought about by the demand for condensing water, forced the conclusion upon the engineers that it was neither wise nor economical to depend on the city mains as the source for this water. Unfortunately, midsummer is the period during which pressure in the city mains is lowest, owing to the fact that fire hydrants are frequently opened to provide street "shower baths." It was decided, therefore, to install a cooling tower on the roof of the thirty-second floor.

The cooling tower will be sectionalized into three forced draft units, the combined capacity of which will be capable of cooling 3800 gal. of water per minute to within 12° of the outside wet bulb temperature. Each tower section will be served by a pump located in the sub-basement, which units will circulate water through the tower 500 ft. above.

Facilities are provided whereby the operator in the sub-basement may throw in or cut out any of the three tower units from his station at the pump controls. The tower fans are, of course, wired for remote control, whereas the sectionalizing valves in the connections at the tower are pneumatically operated.

The tower will be completely concealed between the structures of two large roof signs. These signs have been carefully designed in connection with the tower.

With the inclusion of the equipment described above, it is evident that The Philadelphia Saving Fund Society has spared no effort to become the owners of Philadelphia's most outstanding building.

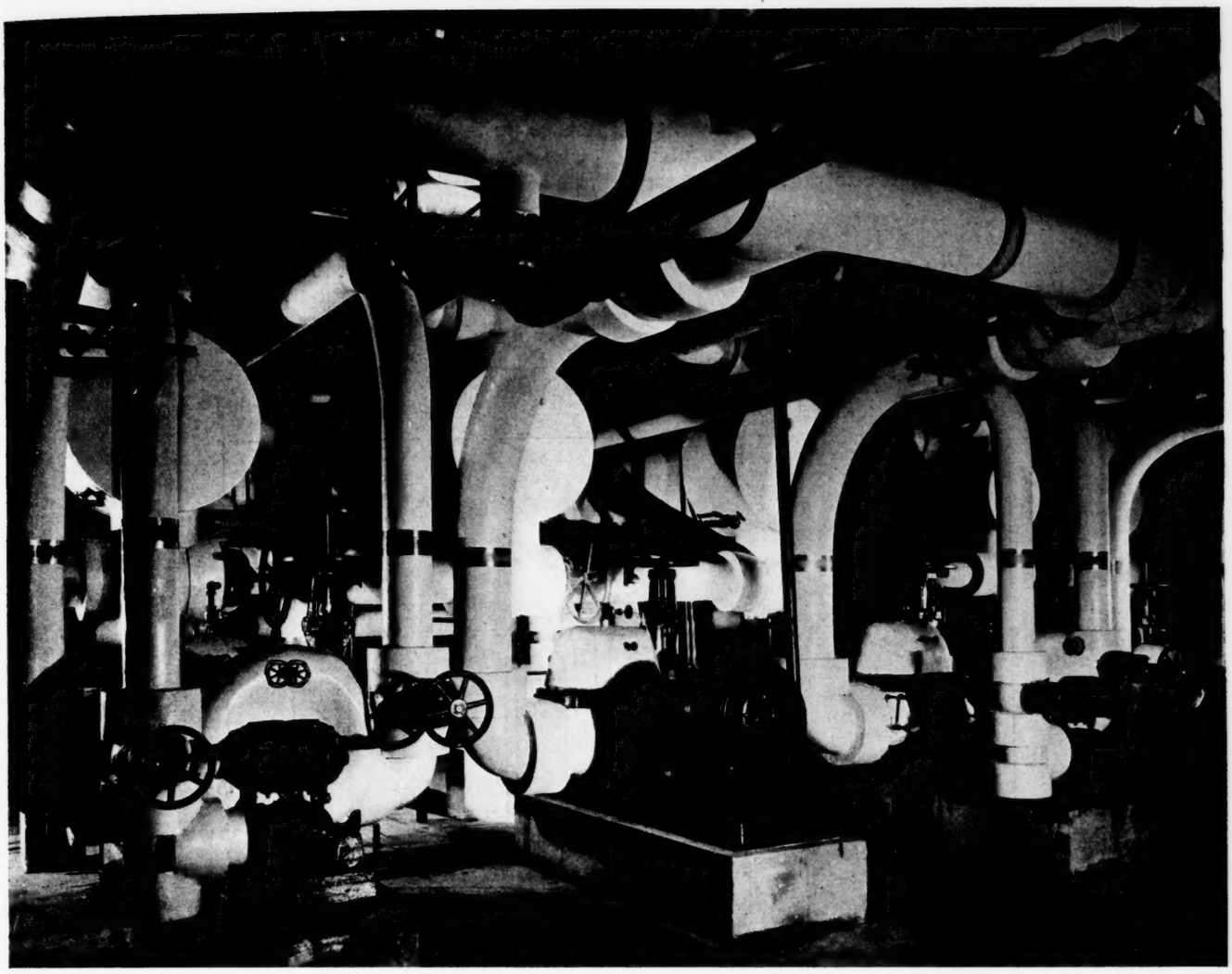


Fig. 1. Pumps and converters for Zones A and B—Cities Service Building

A Hot Water Heating System for a 67-Story Building

II

The system itself, including a description of the ventilation system

By J. A. SPACE†

SINCE the advent of the modern skyscraper—and particularly during the past few years—a statement announcing the construction of a 67-story office building in New York would elicit no more than passing interest; architects, designing engineers, construction men, and building managers have grown to accept such statements as a mere matter of course. To announce the use of hot water as the heating medium for such a building would lift it from the category of the commonplace to a position commanding the attention of all. Sixty Wall Tower, the new building which Cities Service Company has recently added to the skyline of lower Manhattan, is heated by hot water, a system of forced circulation being employed. For this reason, interest on the part of engineers and managers has never waned since an announcement to this effect was made in July,

†Designing Engineer, Henry L. Doherty and Company, New York.

1930. Subsequent to the official opening of the building on May 13 of this year, the general public has become more fully acquainted with its many innovations and, since the provisions made for its heating and ventilation have evoked so much comment, it is quite apropos to publish at this time a short resume of what has been installed in the way of equipment to provide for these needs.

Nature and Occupancy

The building rises 67 floors above the street grade and has three levels below. It is a good example of the tower type of construction which the combination of land values and the set-back requirements of the building code have brought into being in New York. Its side walls of limestone and light-colored face brick have been architecturally moulded into a beautiful structure which has already received from the Downtown League the award as Lower New York's best building of 1931-1932. The first set-back occurs at the tenth floor, all floors below this level occupying the entire area of the site, amounting to slightly more than 32,000 sq. ft. Additional set-backs continue to occur in accordance with code requirements up to the 31st floor, from which point the tower continues with unchanged floor area of approximately 8,000 sq. ft. up to the 55th floor. Above this point small set-backs occur to produce the tapering appearance at the top.

The building has been erected to furnish general office space; floors two to sixteen inclusive will be occupied by Henry L. Doherty & Company and Cities Service Company interests, the balance being rentable space up to and including the 60th floor. Officials and special activities of the Doherty interests will occupy all of the upper floors of the tower, except the glass-walled observation room at the top.

Heating

With the advent of the decision to build came the necessity of choosing between steam and hot water as the heating medium. To decide on the advisability of installing boilers required only a short study easily made; for buildings of this size and type, this question can be quickly answered. The rental value of the space occupied by the coal and ash storage and equipment, as well as by the boilers and auxiliaries, is an item for consideration, but this is dwarfed in a building of this height by the rental value of the space which would have to be taken out of each floor to accommodate the necessary chimney. The principal generating plant of a utility company supplying steam is located within two blocks of the site and practical continuity of service is guaranteed by the existence of primary supply mains in two streets adjoining the building. Because of the proximity of this plant, practically dry steam at a pressure of 135 lb. was available. The desirability

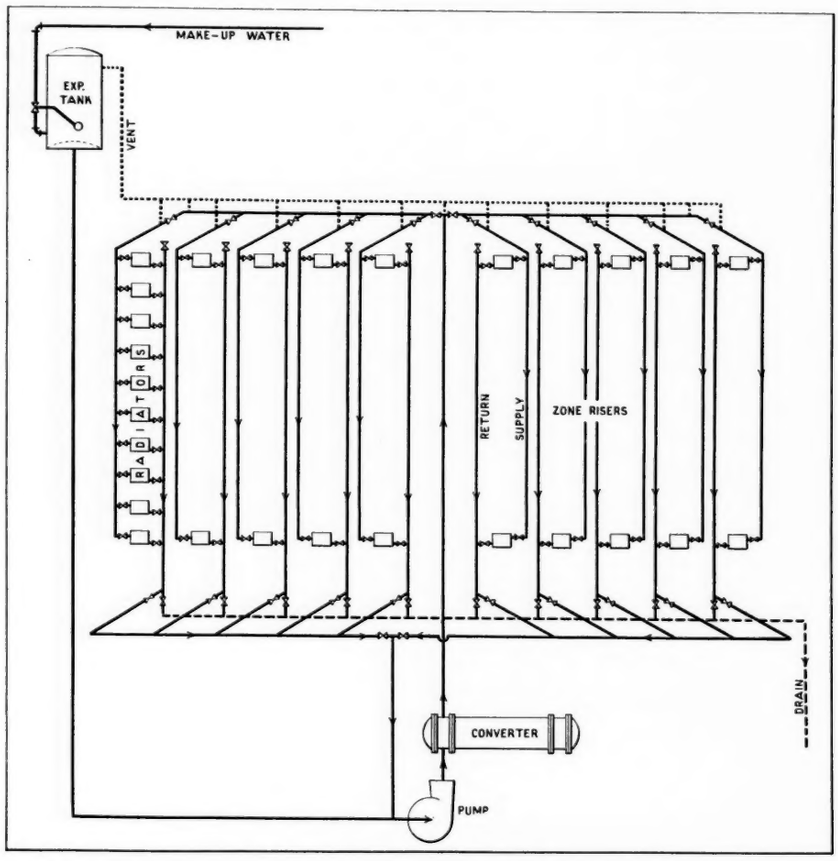


Fig. 2. Diagrammatic view of one hot water zone with cross connections at pumps and converters omitted

of this service over the alternative idea of installing boilers was quickly recognized and the decision was easily made.

The manner of transferring the heat of the steam into the spaces to be warmed was the next item for consideration. It is not the purpose of this article to discuss the relative merits of steam and hot water as heating mediums; each has its advantages and its disadvantages, and likewise its proponents and opponents. Suffice it to say that after very careful studies, which took into account such considerations as initial expense, probable maintenance, space requirements, and desirabilty, it was decided to use a system of hot water employing forced circulation. This use of hot water heat is, however, limited to the rentable space above the first floor, as it was deemed desirable to use steam where required for the first floor and below.

Zones

Regardless of the heating medium employed, flexibility of operation demands that any building of this size be divided into zones, each of which exists as a separate system tied into the others only in that it is supplied from the same original source. In this building there are six separate zones, as follows:

Zone S from sub-basement to and including the 1st floor
Zone A from 2nd floor to and including the 15th floor
Zone B from 16th floor to and including the 30th floor
Zone C from 31st floor to and including the 46th floor
Zone D from 47th floor to and including the 62nd floor
Zone E from 63rd floor to and including the Observation gallery.

As mentioned above, Zone S is heated by means of steam; the heat requirements of the main corridors and vestibules of a building in this sort of service are so variable that steam readiators suitably controlled are most effective in coping with the swings of temperature which may be encountered. All of Zone S is more or less public in nature and because of the large area to be covered and the proximity of a low-pressure steam distributing system an open return steam heating system seemed best adapted to the installation. The entrances are heated by forced hot air, this air getting its heat from low-pressure steam heaters subdivided into sections, each section of which is controlled by push buttons located in the main elevator hall.

The rentable spaces of the first floor have high windows and extensive glass areas, and for this reason the radiation installed below the windows has been subdivided into two sections, one section being controlled from the room thermostats and the other from an outdoor thermostat set for a low temperature to bring this surface into operation during particularly cold spells when downdrafts from the high windows would be encountered. Heat from the balance of Zone S is taken care of with the ventilation, fresh air being tempered in the usual manner by low-pressure steam sections, thermostatically controlled, previous to its delivery into the various spaces.

Forced Hot Water

Zones A, B, C and D are heated by forced hot water. Some may say that to use hot water for heating a building of this height is not orthodox practice, but it should be borne in mind that to heat this building with its zones as listed is no different, so far as the radiators and connecting pipe work are concerned, than heating a group of separate buildings varying in height up to 15 stories, each with its own independent system. The only portions subjected to a pressure greater than that carried in the individual zones are the main vertical feed lines, pumps, and heaters of the upper zones. As described in last month's article in this magazine, radiators of the finned tube type tested for high pressures have been installed, and developments in the power station field during recent years have made available materials for much higher pressures, so that circulating hot water for extremely high buildings need hold no terrors.

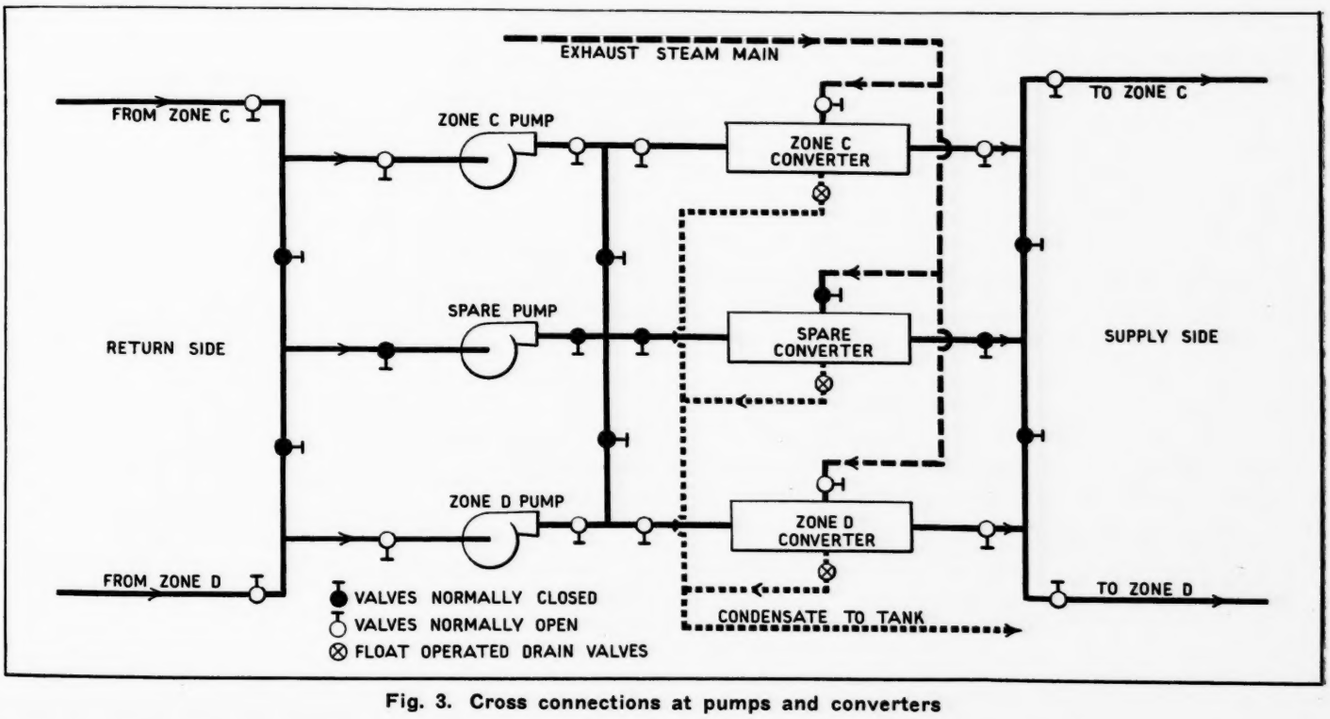


Fig. 3. Cross connections at pumps and converters

Forgetting for the moment the cross connections between the zones which have been introduced at the pumps and converters for the purpose of insuring continuity of service, refer to Fig. 2 and consider the arrangement of one zone (in principle they are exactly alike, varying only in the size of piping required as determined by the B.t.u. requirements of the various zones). Each is a downfeed two-pipe system with a pump and converter located in the sub-basement and an expansion tank located several floors above the top distribution main. Water is forced by the pump through the tubes of the converter up the main supply riser to the supply main which makes a complete circuit of the building at the top floor of the zone. This supply main has valves provided for separately controlling the flow to the north and west sides of the building as distinguished from the flow to the south and east exposures; in this way the north and west sides, normally colder, can be given more heat than the south and east, which are generally influenced more favorably by the heat of the sun and lower wind velocities. The flow from the supply main is downward through the various zone risers which connect into it, thence in parallel flow through the various radiators. Leaving the radiators, the water passes through the return zone riser into the return main located just below the bottom floor of each zone and from which it is led through the main return riser back to the pump for its next journey through the circuit. The return mains for the two "halves" of the building are separately valved further to aid in the distribution of water to the north and west sides of the building as distinguished from the south and east sides.

The chief supply risers and mains, as well as the zone supply risers, are vented back to the air space of the expansion tank and all zone return risers have valves at their highest points for venting out air when the system is being filled. Drain connections for the various zone return risers are provided, all leading into a common drain header running to the sewer and provided to facilitate emptying the system. The expansion tank makes the usual provisions for the volumetric change in the water due to variations in temperature and to keep the system full. New water is admitted to the system through the expansion tank by means of a float-controlled valve which opens to admit make-up only when the water in the tank falls below a predetermined level.

It will be noted that the pump and converter, located as they are at the lowest point of the system, are subject to a static head equal to their distance below the level of the water in the expansion tank, but it will also be seen—and this is important—that the pump has the same static pressure on its suction side as exists on its discharge side and that, therefore, it works against only the friction of the system. This friction determines the power requirements and can be varied by the designer because of his control over pipe sizes; the design is such that the maximum quantity requirements for any zone will cause a friction which does not exceed 60 ft., thus keeping power needs low and bringing the installation well within the range of single stage pumps.

An item worthy of particular mention can be brought out at this point; no floor space has been set aside to accommodate the distribution mains, etc., of the heating system. In some large buildings it has been found necessary to set aside certain floors of low head room to take care of the many pipe lines which must find their way about. Due to the comparatively small size of the mains and zone risers—these are much smaller than they would be if low-pressure steam were used as the heating medium—it was found possible to conceal all zone risers in the furred spaces at the building columns and to take care of both the supply and return mains in what would ordinarily be considered as furred ceilings; the return main of one zone has been run beside the supply main of the zone immediately below it, and both are concealed in the same ceiling duct which is so small as not to occupy any floor space which would otherwise be rentable. These horizontal ceiling ducts occur at the dividing lines between the zones, viz., at the 15th, 30th and 46th floors; a similar duct at the 62nd floor contains only the supply main for Zone D and of course the return main for Zone A is brought down into the non-rentable space below the street grade, so that no duct is required for it.

Continuity of operation is highly essential in a heating system for an office building, and in this respect Sixty Wall Tower has been admirably equipped. In order to guard against any possible interruption of service because of pump or converter troubles, spare equipment has been installed in the manner in which it can be of the greatest benefit. It must have occurred to the reader before this that Zones C and D are almost alike in their requirements and that likewise there is a great similarity between Zones A and B. Advantage of this similarity has been taken in providing spare equipment. A study of Fig. 3 will indicate the equipment and connections provided at the converters and pumps to take care of Zones C and D. A single spare pump and spare converter take care of the needs of both systems, with piping and valves arranged in such a way that the standby pump can function for either of the regular zone pumps and the spare converter can function for either of the two zone converters. Right here it should be mentioned that these three converters are alike and that the standby pump is motor-driven and capable of handling, at synchronous speed, a quantity of water which is about midway between the quantities required for the two zones. It was felt that, for an emergency condition requiring the use of the motor-driven pump, the additional regulation for the zone could be obtained by varying the water temperature. Zones A and B are similarly arranged, with one spare pump and one extra converter arranged to function for either of those normally in operation. It is felt that continuity of heating service is assured for every part of this building.

Zone E is heated by warm air circulated by means of a motor-driven fan, with the usual complement of air filters, tempering stacks, humidifying pan and coil, etc. The air, taken from the outside or recirculated within the zone, is carried to the individual room flues by a system of double air ducts, one carrying warm air and the other air at approximately room temperature. Double mixing dampers are provided—one for each duct connection—both being operated simultaneously by the controlling thermostat located in the room to be supplied. An even temperature is obtained by the

mixing of the cool and warm air under the influence of the actuating damper. The tempering stacks are supplied with hot water coming from duplicate pump and converter units located in the cellar with the others, one of the pumps being driven by a steam turbine while the other is motor-driven.

A resume of the materials employed for the hot water lines may be of interest: seamless steel pipe is used for all lines from the 8 in. main risers of Zone A down to the ½ in. connections for the smallest radiator. Forged steel screwed fittings are used where necessary for all lines up to 3 in. in size, larger fittings where required are of cast steel and of extra heavy flanged pattern. Line welds are used for the mains and the number of fittings has been kept to a minimum on the larger lines by the use of tube turns and welded nozzles. Series 300 flanged cast steel valves are used for the larger lines at pumps and converters, but the sectionalizing valves for the flow and return mains have standard weight iron bodies. Valves, 3 in. and smaller, are medium heavy brass of screwed pattern. Expansion and drain lines, as well as the vent lines which run between the flow mains and expansion tank, are of standard brass. Mains, main risers, zone risers and the lines around the pumps and converters are insulated with standard thickness material, 85% magnesia being used for all except the furred-in zone risers which are insulated with asbestos air cell.

Steam Distribution

As previously mentioned, steam at 135 lb. pressure comes from the street mains of the owning utility, and after being metered is ready for the uses to which it can be put in a building of this type. Considerable of the power in steam at this pressure can be utilized to advantage because of the opportunity for employing steam-driven machinery. Heat is needed during the winter months for both the tempering stacks of the ventilating units and the low-pressure steam system which supplies the radiators of Zone S. All pumps for domestic water have been installed in duplicate; for one set, electric motors furnish the motive power, and to the other, steam turbines have been applied so that they can be used whenever there is use for the steam which they exhaust. As already brought out, the pumps which are normally used for circulating the heating medium are similarly equipped with steam turbine drives, as there will always be use for their exhaust steam when they are in service. One of the air compressors with which the building is equipped is of the steam-driven reciprocating type, completing the list of equipment for which steam is the prime mover.

A back pressure of 5 lb. gauge is maintained in the exhaust header and it is from this line that the converters of the heating zones draw their steam supply. The winter load is such that there is insufficient exhaust steam to take care of the heating requirements and, to provide for this condition, a cross tie from the high-pressure steam line through double reducing valves has been installed. Fig. 4 shows diagrammatically the arrangement referred to and illustrates also the manner in which the heat in the condensate is utilized.

A float-operated drain valve connected to the bottom of each converter opens with a rising water level to drain condensate to the main condensate tank of the building which is located on the cellar floor; this tank also receives condensate from all other equipment where low-pressure steam has been used for heating purposes. City laws require that this condensate be cooled to at least 100° before it is discharged into the city's sewer. To meet this requirement, and at the same time save the heat which would otherwise be wasted, the con-

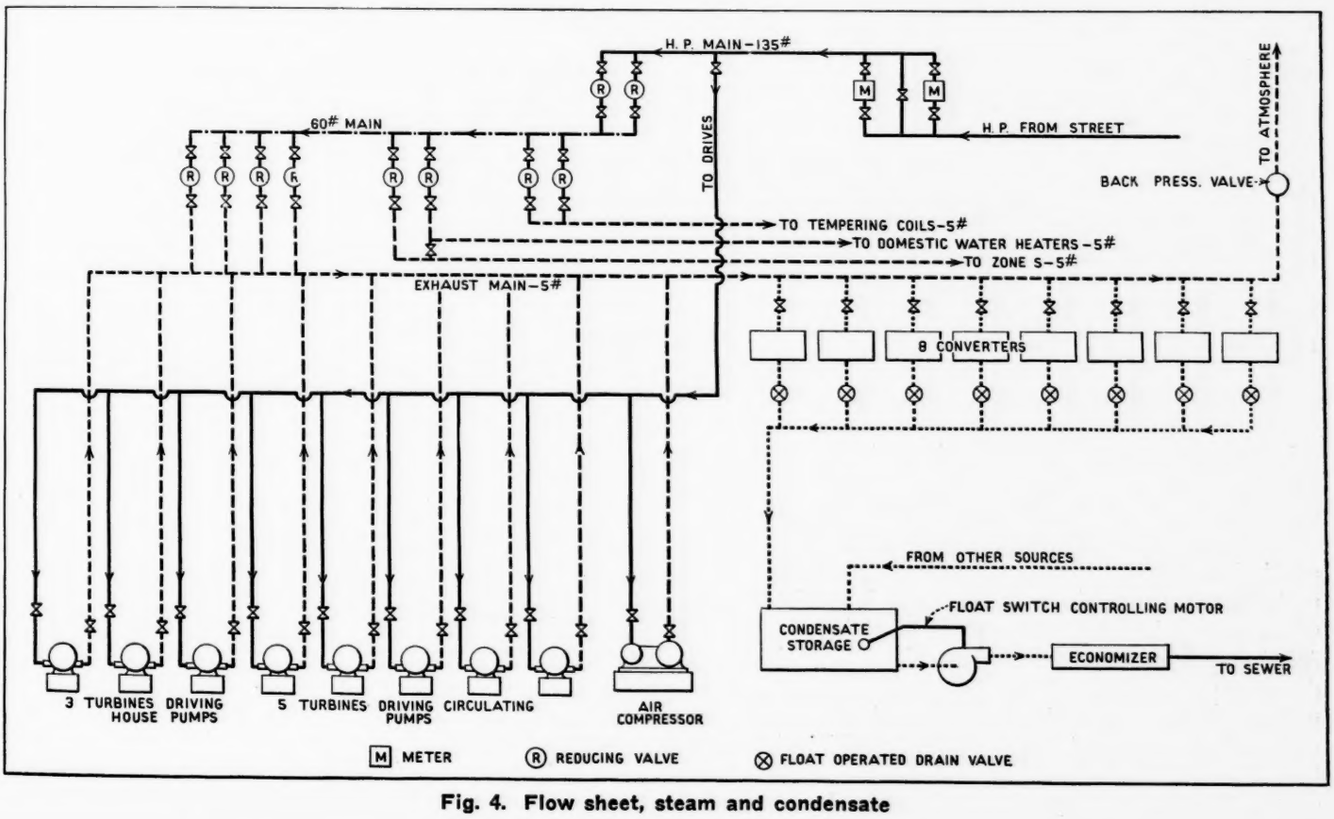


Fig. 4. Flow sheet, steam and condensate

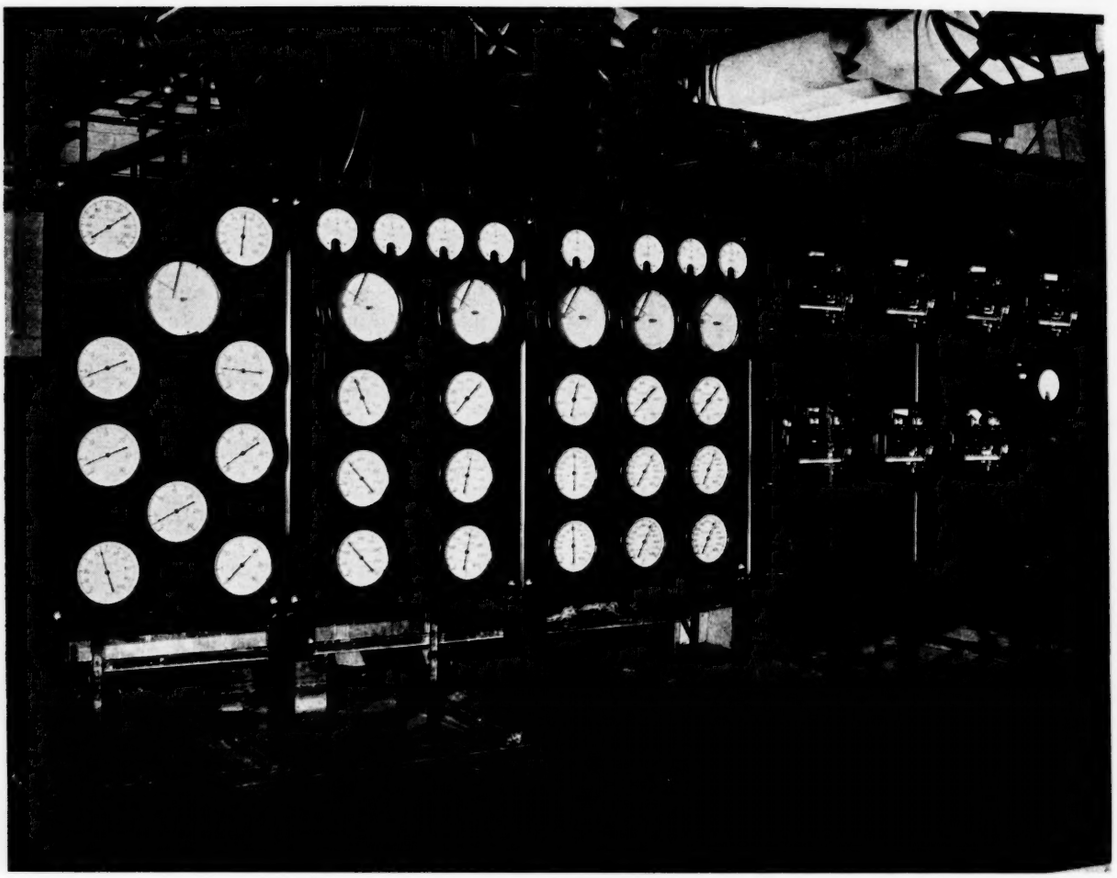


Fig. 5. Instrument panels

densate is delivered by centrifugal pumps (operated by means of float switches) through economizers where it serves to add the first heat increment to the domestic supply of hot water.

Fig. 1 shows the converter and pump installation for Zones A and B. In the foreground can be seen the two turbine-driven centrifugal pumps which are normally operated for these zones, while between them sits the motor-driven pump which can be used in place of either of them. In the background, mounted on structural steel frames, are the three converters which are used in conjunction with these pumps, all as previously described. High-pressure steam, exhaust steam, and hot water suction and discharge lines will be easily recognized.

Pumps and Converters

The converters are of the horizontal shell and tube type, the shell containing the steam space. Water enters the water box at the bottom and after going through two passes of tubes leaves at the top. The converters are designed to heat their respective quantities of water to 210° when there is a temperature drop of 30° and when supplied with sufficient steam at 5 lb. pressure. All circulating pumps are of the horizontal single-stage, double-suction type and are equipped with bronze impellers. Converters and pumps are all of such design as to safely withstand the pressures to which they can be subjected due to the static heads of the various zones. All of the equipment and piping in the hot water heating system have been tested to pressures 50% higher than those under which they will operate. The following tabulation shows the quantity of water to be circulated through each zone as well as the calculated friction for each zone when circulating this maximum quantity; in addition, the pump speeds for this condition are given.

Pump Drive	Water Quantity G.P.M.	Dynamic Head in Ft.	Pump Speed R.P.M.
Zone A—Steam turbine.....	1735	60	1860
Zone B—Steam turbine.....	904	60	1695
Zones A and B—Electric motor.	1400*	..	1750
Zone C—Steam turbine.....	482	60	1920
Zone D—Steam turbine.....	405	60	1750
Zones C and D—Electric motor.	400*	..	1750
Zone E—Steam turbine.....	105	60	1750
Zone E—Electric motor.....	105	..	1750

*These figures are the quantities which will be delivered by the spare motor-driven pumps at their synchronous speeds.

Ventilation

Last month's issue of this magazine described in some detail provisions made for the installation of unit ventilators in rentable space above the fifth floor; ventilation for the balance of the building has been taken care of in the usual orthodox manner. Fresh air from central systems is distributed through sheet metal ducts to the various rentable parts of the floors below the fifth, including of course the rentable sections of the ground floor and basement. Secondary air supply is secured by discharging, into the pump and machinery spaces of the sub-basement, air exhausted from rent-

able space where normal room temperatures will be maintained and where there is no absorption of excessive heat nor possibility of contamination through overcrowding. Damper control has been provided for certain units of this secondary air supply to permit discharging this exhausted air to the outside of the building if necessary.

All the fresh air supply is taken in on the north side of the building and, after passing through dry type filters, is tempered by means of heating stacks on which thermostatic temperature control is maintained. This fresh air is heated to approximately room temperature and is then passed over water evaporating pans containing submerged steam coils, so that the relative humidity can be varied. Provision is made in each air supply fan unit for the installation of cooling coils, so that the air supplied by these fan units can be cooled if the necessity arises. Floor space in the cellar has been set aside for the installation of refrigeration machinery of sufficient capacity to take care of the needs of the whole building. There are eight central supply systems, having a maximum output of approximately 160,000 cu. ft. of air per min.; the combined capacity of the units assigned to secondary air supply is approximately 90,000 cu. ft. per min.

A central system of air exhaust has been provided for the ventilation of the escalator and elevator machinery spaces and toilet rooms up to and including the 19th floor. No air is supplied to these spaces, the make-up air to these rooms being taken from the floor spaces through louvered openings in the doors in order to insure a positive inflow of air to these rooms. The air exhausted from the escalator and elevator machinery spaces is for heat removal only and together with the air removed from the toilets is discharged to the outside of the building at the 19th floor level on the south side. A great quantity of the fresh air supplied to the lower floors of the building eventually finds its way by means of the recirculating systems into the pump and machinery spaces of the cellar, and it is on this same space that the largest exhaust unit is working. The total capacity of the exhaust fans is approximately 210,000 c.f.m.

All supply and exhaust ducts are of the usual sheet metal construction, with fire dampers where required and properly insulated where necessary. They have been designed along conservative lines, so that no fan is required to work against a static pressure in excess of 1½ in. Fans have been chosen for quietness, a requirement of paramount importance in this type of building.

A large vertical duct from the cellar to and terminating above the 31st floor has been provided for exhausting air from kitchen spaces. No fans have been provided for any kitchen ventilation. These will be installed when and as required.

Instruments and Control

In order that the engineers may intelligently operate any heating and ventilating system, it is important that they have before them necessary and accurate information concerning the spaces to be heated. It is of prime importance that they know not only the exterior weather conditions, but also the conditions existing on the various floors of the building. A complete system for temperature detection has been installed so that the operator can read at a glance the temperature of the air on any floor of the building and can also have a record of both the wet and dry bulb temperatures existing in the ducts of the central supply systems.

All of the instruments required for the proper operation of the heating and ventilating systems have been grouped in the room housing the heating apparatus, where they are mounted on slate panels. Fig. 5 shows this board in detail. On the panel at the extreme left there is mounted one recording instrument which will show the pressure of the incoming supply of steam to the building, as well as indicating gauges to show the pressures existing in the various low-pressure steam distributing lines. The next two panels contain five sets of instruments arranged vertically, one set showing the conditions in each of the five hot water heating zones. At the top of the board there are two electrically-operated temperature detectors showing the temperatures on two of the key floors in the zone; immediately below this is a recorder showing the temperature of the water discharged to that zone's supply main. Below this recorder there are three indicating gauges showing the level of the water in the expansion tank, the pressure on the suction side of the circulating pump, and the pressure on the discharge side of the circulating pump. The two panels at the extreme right of the board mount seven multi-point temperature recorders which will produce records of the wet and dry bulb temperatures of the central supply systems, and also an electrically-operated temperature indicator. By means of multi-point switches it is possible to read the temperature existing outside of the building, and also on each of the various floors. In addition to these instruments mounted on the board, there are indicating thermometers installed in the circulating lines as they enter and leave the converters; their thermometers appear in the photograph, Fig. 1, and are so located in order that they will be handy to the operator as he regulates the flow of steam to the converters in accordance with the information which they give.

The hot water heating system was put into service during February of this year and, in view of the unusual weather conditions existing, it can hardly be said that it has been subjected to any real test. Before authentic operating results and economies can be shown, it will be necessary to have more complete data. However it can be said at this time that results have been very satisfactory up to the present. With a considerable part of the building plant in operation, it has been found necessary to have on duty during each shift only one operating engineer whose task of looking after all of the house machinery located in the sub-basement has not been particularly arduous. In spite of the generous provisions made for working space around pumps and piping, the total space occupied for these building facilities is small and the compact arrangement and logical grouping of equipment are very great aids in making this ease of operation possible. To hazard any predictions is more or less idle, but, from such preliminary figures as are available at this time, it seems conservative to say that the heating and ventilating of Sixty Wall Tower will compare quite favorably with that of any building of its type in the metropolitan district.

Making the Rounds with a SERVICE *Man*

Part III

By
V. D. Milliken

When Doc and Mac arrived at the second trouble job on their list, they found it to be an average-sized apartment building, equipped with a vacuum heating system, employing an automatic oil-fired boiler with an automatic boiler feeder. A letter from the owner had reported that at times the vacuum pump did not discharge the return condensate to the boiler, with the result that the water in the gauge glass often dropped out of sight.

* * *

"I'm going to let you locate the trouble on this job, Mac," said Doc. "Just take your time and watch everything."

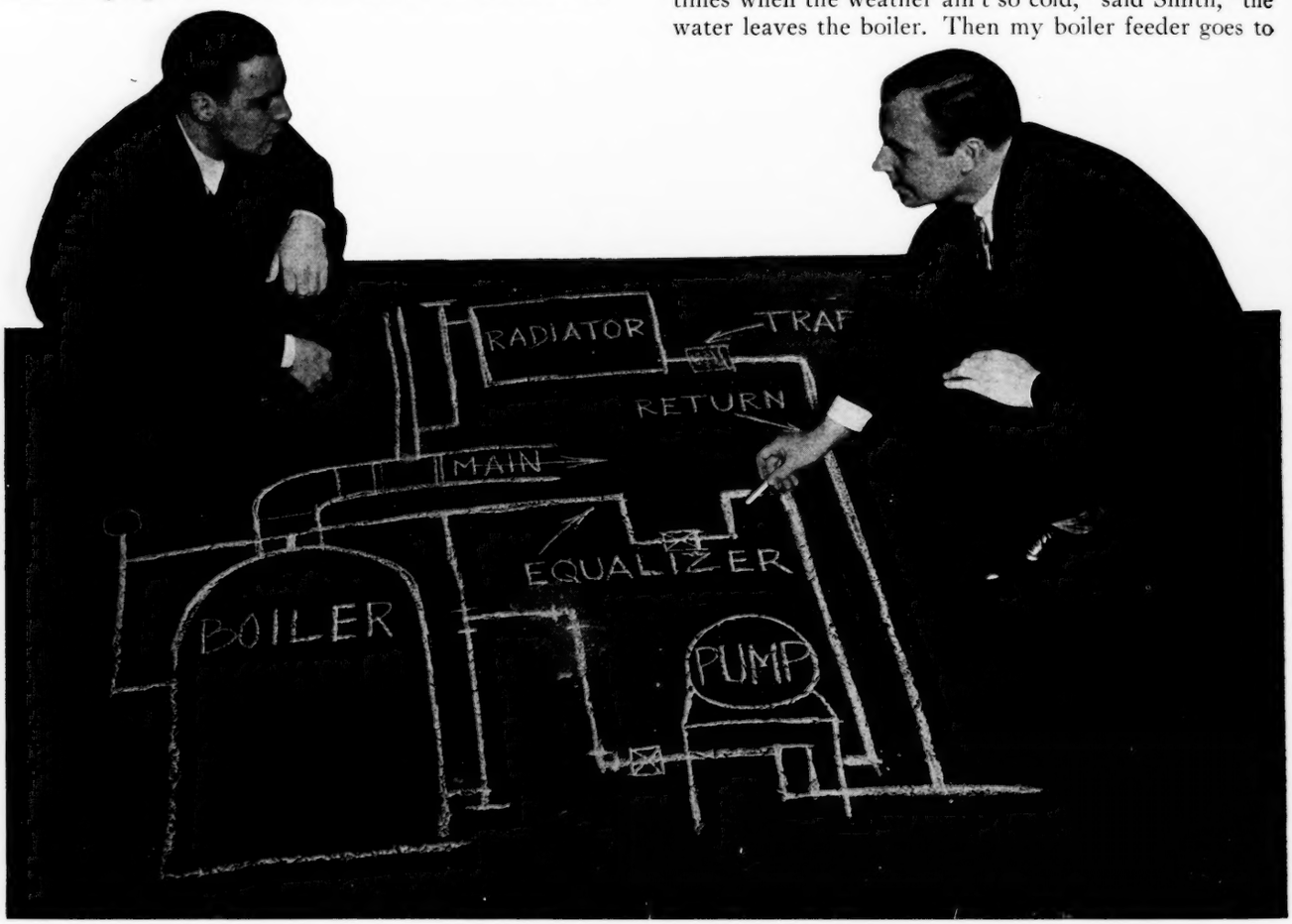
"Gee, that's a large order for a beginner, but here goes," replied Mac, greatly pleased.

He first walked over to the vacuum pump, read the vacuum gauge and touched the return lines cautiously. He then glanced at the combination vacuum and pressure gauge on the boiler. At that moment the oil burner was tripped out by its automatic control.

"Two pounds pressure on the boiler and the return lines are fairly cool, which indicates that the traps are in good condition, and now the vacuum pump has stopped after pulling a vacuum of seven inches. Looks like everything is O.K. so far," reported Mac.

The janitor entered the boiler room and after the usual preliminaries Doc said, "Tell us, Mr. Smith, just what happens and when it happens."

"At night, after I shut off the oil burner, and sometimes when the weather ain't so cold," said Smith, "the water leaves the boiler. Then my boiler feeder goes to



Doc reached for the chalk and drew the equalizing line in place.

work and after a while the boiler is flooded. The people complain about the radiators knockin' and when I get here I open the blow-off valve and let a lot of water out and then it works all right."

"Is there a vacuum on the boiler when you get here?"

"Yes, sir, and when I open the blow-off valve it sucks in air for a while," replied Smith.

"Thanks, Mr. Smith," said Doc. "Now, Mac, do your stuff."

Mac had been listening closely, and now that he was to 'do his stuff', he said to Smith, "Will you show me how you arrange everything for night operation?"

"Sure," replied Smith. "First, I push this button here on the oil burner control. That keeps the oil burner from gettin' up steam. Then I switch the vacuum pump over to float control by turnin' this switch."

Mac thanked him, noted the vacuum indicated on the vacuum gauge at the pump and glanced at the gauge on the boiler.

What Has Gone Before

Doc White, the service engineer for a large heating contractor, has engaged a new assistant by the name of McKay. While Mac understands the theory of steam heating, he has had no practical experience. Doc explained to him the elements of vacuum heating, following which they inspected a job where the pump failed to pull enough vacuum. Mac learned how to locate a leaky line, which in this case happened to be underground.

"The vacuum is about six inches and the pressure on the boiler has dropped to one-half pound. How long does it take for something to happen, Doc?"

"Oh, it may take twenty minutes or more," replied Doc. "While we are waiting I would suggest that you make a sketch of an elementary heating system. I think you will be able to reason things out better if you have a sketch."

Mac followed Doc's suggestion and made a rough diagram of a simple vacuum system on the floor with chalk. Shortly after he had finished the sketch they heard a hammering noise which gradually became louder. Mac again noted the conditions as shown by gauges.

"The vacuum on the return line has decreased to three inches of mercury, but look at the vacuum on the boiler!" exclaimed Mac in surprise. "That gauge shows a vacuum of six inches. Gosh, that is more than we have on the return line. The water line in the boiler has dropped, too. How do you account for that, Doc?"

For answer, Doc merely smiled. Mac looked puzzled but his expression soon changed to one of thoughtfulness. A few minutes elapsed during which Mac consulted the sketch he had made. "I believe I know the cause for some of this, but I can't account for the vacuum on the boiler being higher than the vacuum on the return line," he said. "As the steam from the boiler condenses, it creates a vacuum due to the much smaller volume of an equal weight of water as compared to steam. I can also see that with a greater vacuum on the boiler than on the return line the condensate would be held up in the radiators, which would account for the lower water line in the boiler and the hammering in the radiators."

"Did you include the traps on your sketch?" asked Doc.

"Yes, I did," replied Mac, realizing that Doc was giving him a tip. After a few moments' reflection he continued, "Oh, I see what you are driving at. The traps haven't cooled sufficiently to open and, therefore, the vacuum on the steam side of the system is independent of the vacuum on the return line. Until the traps open, the vacuum on the boiler will be higher. Isn't that correct, Doc?"

"You are getting the idea all right. Now figure out a way to make the system work properly and then I'll explain a few things to you."

"Well," began Mac, "if the vacuum on the boiler is the cause of the trouble, just put a vacuum breaker on the boiler to prevent a vacuum."

"That will prevent the condition which causes trouble on this job," said Doc, "but at the same time it will introduce other difficulties. For example, suppose there is a vacuum breaker on the boiler so that no vacuum can be formed. Then suppose that the vacuum pump is operating on vacuum control, and that the traps are open. The pump, under these conditions, will attempt to create a vacuum on the boiler, but since the vacuum breaker will admit air to break the vacuum, the pump will be caused to run continuously. You don't want the pump to run continuously, do you?"

"No, but the janitor should be instructed to operate the vacuum pump on float control," responded Mac.

"That's right, Mac, but a lot of cold air will be admitted to the system. In mild weather when a small amount of heat is required it is economical to operate the whole system, including the boiler, under a vacuum to take advantage of the lesser amount of heat given off by the radiators. If you let in a lot of cold air there will be practically no heat in the radiators, and then the pump will have to work overtime to remove all the air when you switch over to vacuum control."

"Well, then, why not set the vacuum breaker to operate at a vacuum slightly higher than that at which the vacuum regulator is set to stop the pump?" asked Mac. "Then the pump would not run continuously."

"I've been playing a dirty Irish trick on you, Mac, but I want you to clearly understand when and why you should and shouldn't use a vacuum breaker," ad-

mitted Doc. "Don't you see that we are right back where we started? If the vacuum regulator is set to stop the pump at seven inches, your vacuum breaker on the boiler, according to your reasoning, should be set slightly higher than seven inches. Now, a few minutes ago, there was a vacuum on the boiler of only six inches, which is below the setting you recommend for the vacuum breaker on the boiler, and we had plenty of trouble, didn't we?"

Mac was a little bewildered but he saw the point and said, "Again I have neglected to take into consideration all operating conditions. I can see that the vacuum breaker is not a cure-all, but I haven't yet discovered a means of accomplishing what we want."

Doc came to the rescue. "Supposing we find a method of equalizing the differential vacuum so that if the vacuum on the boiler becomes greater than the vacuum on the return line, the connection which we make will effect an equalization and permit the condensate, which is now being held in the radiators, to return to the pump by gravity."

"I see it now," exclaimed Mac, eagerly. "If we run a pipe from the boiler to the return line with a check valve opening toward the boiler, then a higher vacuum on the boiler will open the check valve and the vacuum on the boiler and on the return line will become equal. When there is pressure on the boiler, the check valve will be held closed."

"Now you've got it, Mac. There are a few precautions which I will add, though, to prevent other troubles."

Doc reached for the chalk which Mac had in his hand, and drew the equalizing line in place. "You may connect into the boiler or steam header at any convenient point above the water line. Pitch the pipe slightly upward from the boiler so that it will drain. Install the swing check valve at the bottom of the little dip in the line as I've drawn it. That dip is known as a seal and is made up of close nipples and elbows. There is always enough condensate in this equalizing line to fill the seal, thus the swing check valve is water sealed and tight. Then we drop this equalizing line to the top of the accumulator tank of the pump. It is very poor practice to connect into the return line because under certain conditions, which we will dig into later, the return line may be full of water. If the equalizing line is sealed with water, it is obvious that a higher vacuum on the boiler will lift water into this line. For example, we had a six-inch vacuum on the boiler a short while ago, and three inches on the returns at the pump, making a three-inch differential. With the equalizing line sealed with water as I have described, the three-inch differential vacuum would lift a column of water into the vertical pipe to a height of approximately three feet. We would then have a balanced condition, but no equalization whatever. On the other hand, if we connect the line into the top of the accumulator tank or hollow base of the pump, we are assured that it will not become sealed with water, because the float will trip in the switch and start the pump before the condensate reaches that height. Is that all clear to you?"

"It sure is," replied Mac, "although I don't think I'd have understood it without that diagram."

"Good," continued Doc. "Now, the vacuum breaker comes into the picture. Some pumps have vacuum breakers or relief valves on the accumulator tanks, while others do not. If there is no vacuum breaker on the tank, then one should be installed. The best place to put it is in the equalizer line because you can provide a place for it when you make up the fittings for the line, although it is equally effective either place. Naturally, the vacuum breaker is set to open at a slightly greater vacuum than the setting of the vacuum regulator. If the vacuum breaker is set too high, it will impose a suction lift on the pump which may prevent the pump from returning the condensate to the boiler. In short, the vacuum breaker functions correctly only when installed with an equalizing line."

"I understand when it should and should not be used now," said Mac.

"Another good stunt," Doc continued, "is to install an air vent valve or air displacement valve in the equalizing line so that air may escape rapidly from the return line when the pressure is building up and forcing the air out ahead of it. Under such a condition the air, if permitted to escape freely, would be removed at a faster rate than the pump could remove it, therefore the air displacement valve expedites the warming-up period in the morning."

"I've certainly learned a lot on this job, thanks to you, Doc," said Mac.

"That's great, Mac. We'll pick up some more knowledge on the next job because I think it's a bit different."

The janitor had returned and Doc explained briefly the cause of the trouble and how he proposed to remedy it. The janitor was instructed to open the try-cock on the water column above the water line for night operation, until the equalizing line was installed.

Mac now has considerable confidence in the equalizing line idea. On the next job, however, he finds that there can be trouble even when such a line has been installed.

San Francisco's skyline

R. G. & W. M. Cory, architects and engineers — *Hubbard & Lange, Inc., heating contractors* — *Starrett Brothers & Eken, Inc., builders*

Fig. 1. Starrett-Lehigh Building, 26th to 27th Streets, 11th to 13th Avenues, New York

A Zoned Temperature Control System for an Industrial Utility Center

By A. F. HINRICHSEN† and CHAS. HARTMAN‡

A description of the method and devices employed in the control of unit heaters in the Starrett-Lehigh Building.

SEVERAL unusual features in building construction are embodied in the new Starrett-Lehigh Building, New York. The structure was designed to provide light manufacturing and shipping facilities for manufacturers who have difficulty in securing adequate facilities due to the relatively small size of their businesses. A particular feature of the design is the arrangement by means of which trucks can load and unload on every floor, the routing of the trucks being such that there is no traffic congestion or counter flow of traffic within the building. Railroad cars are accommodated on the ground floor.

Another interesting point is that the building is of cantilever construction so that, as the exterior view shows, the tenants receive the maximum amount of light, even at the corners. There are approximately 100,000 panes of glass in the building, and the large area of this glass added to the problem of effectively heating the building.

With the cantilever construction the columns, which ordinarily are part of the outside walls, are set back. Unit heaters were located around the space between the columns and windows so as to prevent the large heat loss from chilling the inside spaces. The 477 unit heaters circle the building, so that the air flow set up is in one direction.

A flexible system of control for the unit heaters is provided. This consists of two definite and separate types of equipment: the thermostats, which are of the dual type, for day and night operation, and the zone control apparatus in the basement.

Each thermostat is centrally located as regards the

†President, A. F. Hinrichsen, Inc., New York.
‡Field Engineer, A. F. Hinrichsen, Inc.

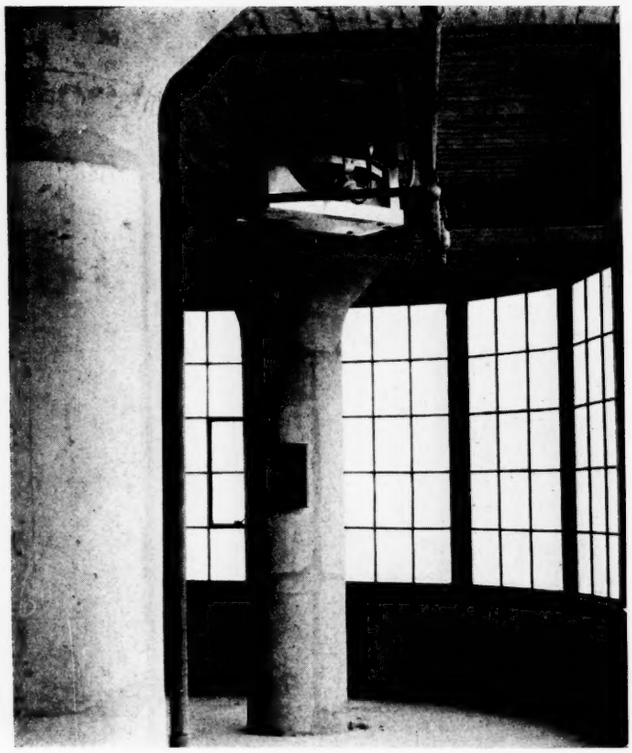


Fig. 2. A unit heater at a corner of the building, placed at an angle to bend the air stream so as to circle the walls. The thermostat and cabinet for the group of units, of which the heater illustrated is a part, are located on the column

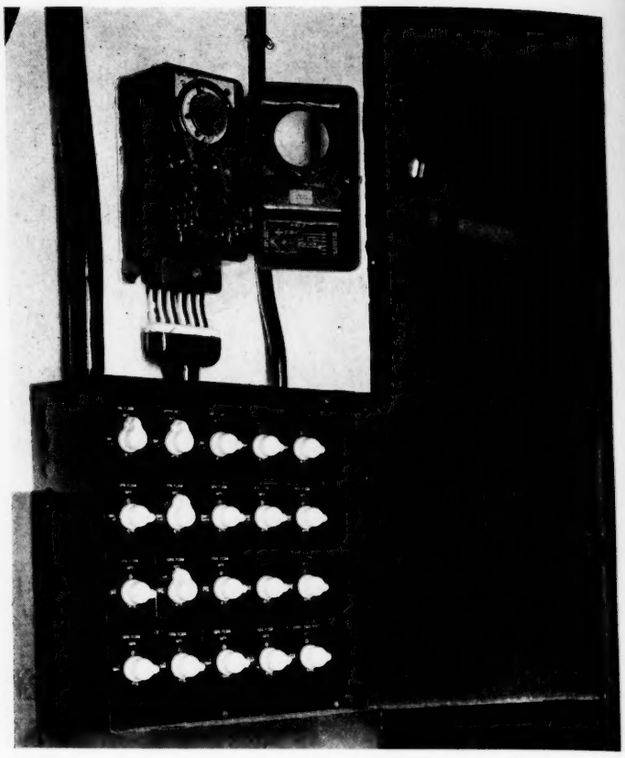


Fig. 3. Master clock and zone control board, located in the basement

group of heaters it controls and is mounted on a cabinet which contains the auxiliary control equipment. Inside of the thermostat are mounted two separate bimetallic elements, each of which has a range of 55°-85°. In this particular installation one of the elements is adjusted for a day temperature of 70°, the other for a night temperature of 55°. The instrument is equipped with a locked guard which prevents any but authorized persons from changing the temperature setting.

Located inside of each cabinet are a day and night relay, starter relay, transformer and a magnetic starter. The day and night relays are controlled by a master clock and zone control board located in the engine room. The function of the day and night relays is to switch the control of the thermostats. During the day the control is on that thermostatic element adjusted for 70°. At a predetermined hour in the evening the control is automatically transferred to the thermostatic element adjusted for 55°, thereby carrying a lower temperature through the night.

The wiring between the thermostat and the starter relays is low voltage, the transformers located within the cabinets supplying 20 volts for this circuit.

Operation within the cabinet is as follows: The thermostat is calling for heat. The movable blade attached to the bimetallic element makes contact with the *on* contact in the thermostat; this, in turn, energizes one of the magnets on the starter relay, which tips the mercury tube, closing the circuit to the solenoid coil of the magnetic starter. The starter then closes the circuit between the power supply and the fan motors on the unit heaters connected to the thermostat. When that portion of the floor controlled by this thermostat has reached 70° the movable blade then makes a connection with the *off* contact of the thermostat which energizes the opposite magnets of the starter relay. This tips the mercury tube in the opposite position, opening the circuit to the solenoid coil of the automatic starter. The circuit is thus broken between the power supply and the unit heaters and the fan motors stop. There is a total of 147 thermostats and control cabinets operating the 477 unit heaters, the sequence of operation being the same in each cabinet.

In the engine room are located a master clock and a zone control board. The master clock is electrically wound, which prevents it from becoming inoperative should there be current failure. Should a current failure occur the main spring of the timepiece has a reserve of 3½ days. The master clock is equipped with two dials, the large one known as the daily dial, calibrated for the 24 hr. in a day, and the small program dial divided off for the seven days of the week. Each day is subdivided into 24 hr. The daily dial revolves once in 24 hr., the program dial once in seven days. The function of the daily dial is to control the hour at which the 70° or day temperature thermostat is to have control and at what hour the day temperature unit is to go out of control, and the 55° or night temperature unit is to assume control. The function of the program dial is to keep the building on a lower or night temperature over a prolonged period of time, such as from noon on Saturday until Monday morning, while the building is unoccupied.

The operating schedule for this building is as follows: At 7 a.m. the clock places all the day thermostats in control, keeping all portions of the building at 70°.

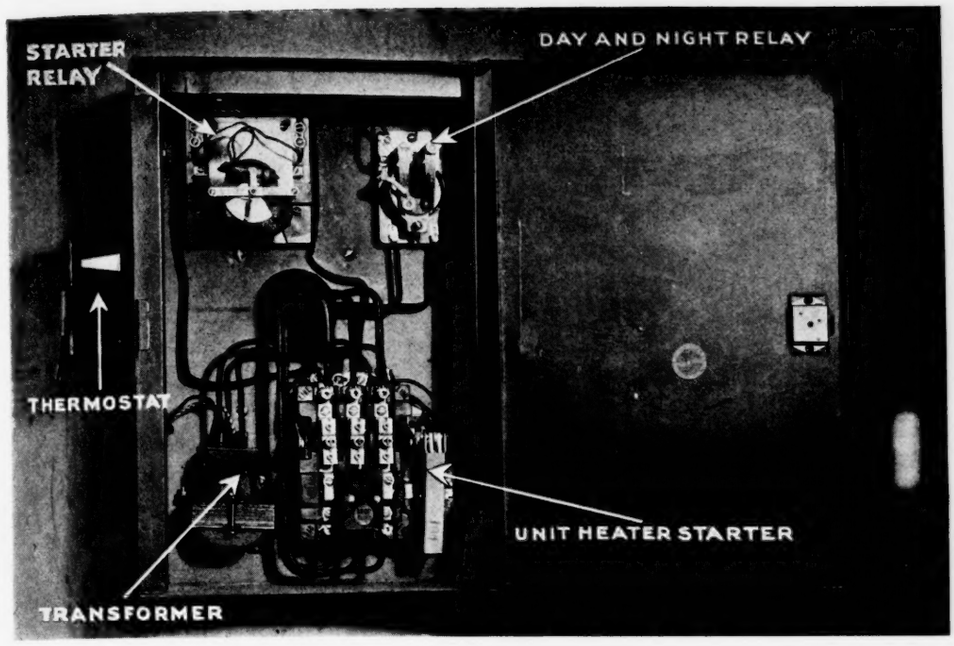


Fig. 4. Close-up of interior of control cabinet

At 5 p.m. the clock switches control of the temperature to the night thermostat, thereby maintaining a lower temperature during the period the building is unoccupied. At 7 a.m. the night thermostats are relieved of the control and the day thermostats are placed in circuit again. This schedule takes place from Monday until Friday. On Saturday at noon the program dial switches control from the daily dial and places the night thermostat in control, putting the building on a night temperature schedule from noon on Saturday until Monday morning. This operation is fully automatic. The hours at which the different temperatures go into effect are determined, and the dials set, at the time of installation.

The zone control board has a number of rotary switch handles, there being as many switches as there are floors. Each floor is considered as one zone. On the outer edge of each switch are three notations, Night, Day, and Automatic. These switches permit the engineer on watch to take control from the clock control on any floor or number of floors. For instance, if it is desired that all floors be under control of the clock, all the switches are rotated so the pointers are set at Automatic. If the twelfth floor is unoccupied, the engineer on watch rotates the switch marked 12, so that the pointer rests opposite the word Night. This keeps all the thermostats on the twelfth floor on the lower temperature side at all times, regardless of the clock placing the remainder of the thermostats in the building on the day side during the usual working hours.

If, for example, the tenant occupying the eighth floor desires to have his employees work overtime, say, until 10 p.m., he informs the engineer to that effect, and the engineer rotates the handle on the switch marked 8 so that the pointer rests opposite the word Day. Then all the thermostats on the eighth floor will remain on the day side, regardless of the clock which places the remainder of the thermostats in the building on the night side at 5 p.m. Proper instructions are left for the engineer or night watchman, and when it is 10 p.m., the eighth floor switch is placed back to the automatic position, and the clock again has control of the eighth floor together with the rest of the building. Thus, the zone control board allows complete control of the heating system as regards any unusual conditions which may arise, such as satisfying a tenant, and also for economizing heat in the unoccupied floors.

Equipment

Boilers—Babcock & Wilson Co.
Unit heaters—Grinnell Co., Inc.
Pipe—National Tube Co.
Traps—Warren Webster & Co.
Direct radiation—U. S. Radiator Corp.
Oil burners—Todd Oil Burner & Engineering Corp.
Valves—The Lunkenheimer Co.
Fittings—Crane Co.
Pumps—Dean Bros. Co.
Soot blowers—The Bayer Co.

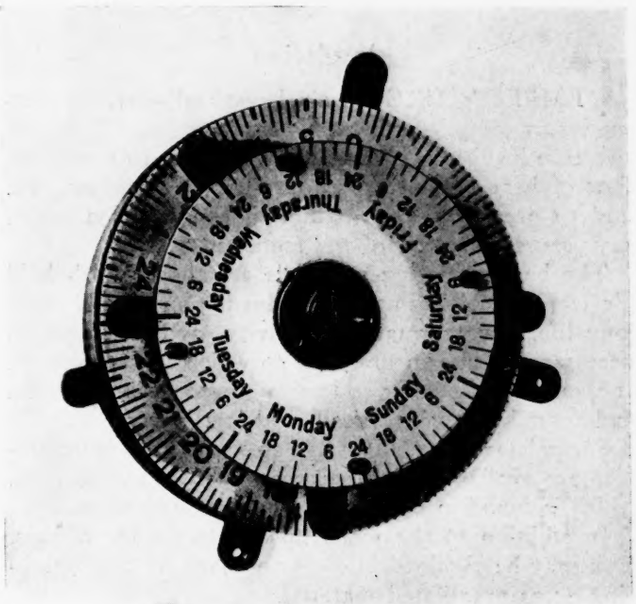
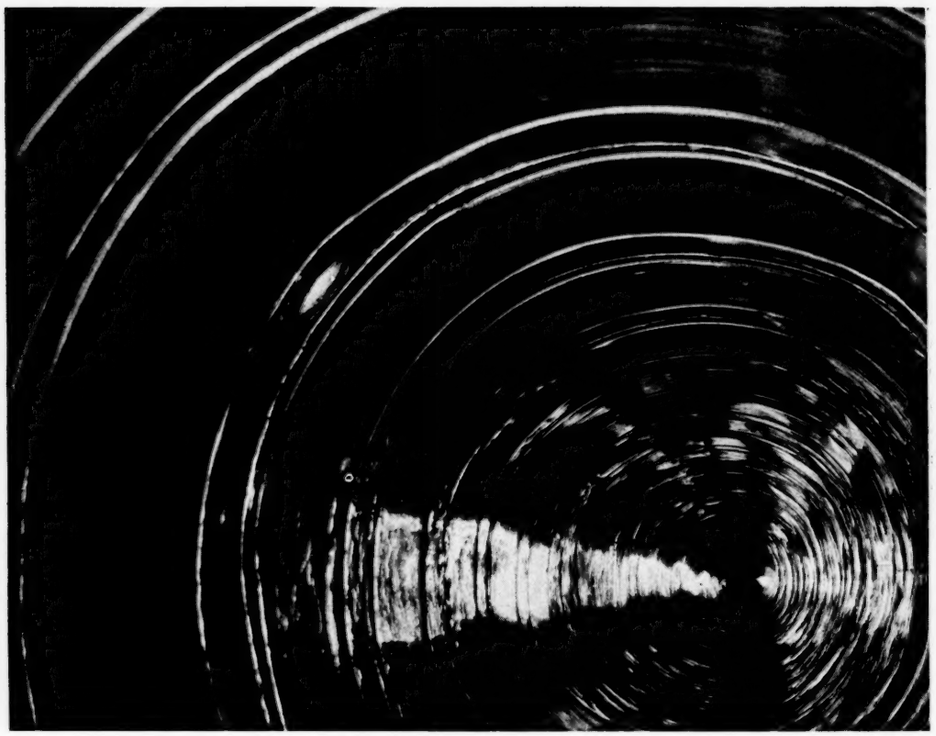


Fig. 5. Program dial of master clock



Eastman Kodak

A view through an air conditioning duct

Air Conditioning

XX—Heat Insulation and Sound Isolation

By WILLIAM HULL STANGLE
and
REALTO E. CHERNE†

Insulation

TEMPERATURES of air, brine and water circulating in air conditioning systems are such that low temperature insulation is generally necessary to retard the flow of heat inward or outward, as the case may be, and to prevent the formation of condensation which may cause corrosion of the metallic surfaces.

The best insulating materials are those which hold air confined in minute cells. Insulation should have long life, low thermal conductivity, and the strength necessary to sustain any load to which it is subjected. It should be oil, water and vermin proof, fire retarding, and must be easy to install, and low in cost.

Several materials adaptable to low temperature service are available commercially. One of these is cork, which is found in two varieties, vegetable and mineral.

In addition to the many special forms for fittings, cork may be obtained in sheets or slabs for use as lagging or as granulated material.

†Carrier Engineering Corporation.

Sheet cork can be used on all flat surfaces such as walls, floors, ceilings, ducts, apparatus, connections, etc. The standard size sheets or boards are 18 in. x 36 in. for mineral cork, and 12 in. x 36 in. for vegetable cork. Standard thicknesses of mineral cork are 1, 1½, 2, 2½, 3 and 4 in., while for vegetable cork the thicknesses are ½, ¾, 1, 1½, 2, 3, 4 and 6 in. Cork lagging can be used to insulate cylindrical surfaces such as tanks, coolers, and large diameter pipes. The lengths, widths and thicknesses are dependent upon the diameter of the cylinder being insulated and the service intended.

Granulated cork, used for insulating between studs, filling around pipes in trenches, etc., is a loose, moisture-resisting filler.

Covering of the pipe is a different problem. Standard thicknesses of pipe covering are available for different temperature differentials.

Although it might be considered more scientific to calculate the exact thickness of insulation to use for any application, this is rarely done in present day practice. With many of the factors practically constant,

the heat transmission from one medium to another is relatively constant, resulting in a standardization of the thicknesses of insulating materials for definite applications.

Pipe covering as used for refrigeration is made in three thicknesses: approximately 1½ in. thick, called ice-water thickness for temperatures not lower than 25° F.; approximately 2½ in. thick, called brine thickness, where the temperatures range between 0° and 25°; approximately 4 in. thick, called special brine thickness, where the temperatures are from 0° to 30°.

Application of the Insulation

Cork insulation may be applied to masonry or metal surfaces. Stone, brick or concrete walls should be smoothed off to a reasonably even surface. Rough surfaces should be given a screed or leveling coat of portland cement plaster. Masonry walls should also be given a coat of concrete primer. Metal surfaces should be thoroughly cleaned.

Masonry or metal surfaces should be given a coating of hot asphalt to provide complete protection against air, moisture or actual water infiltration, and to provide a satisfactory adhesive material for the insulation.

The insulation is embedded in the hot asphalt, care being taken to obtain tight joints. On metal surface covering the insulation is reinforced by wrapping or tying with wire to hold the pieces in place. When a double thickness is applied, the surface of the first layer is thoroughly mopped with hot asphalt, and the second layer embedded in the adhesive. The surface of either single or multiple thickness insulation is coated with hot asphalt. When the asphalt has thoroughly cooled and set a finishing coat is applied.

Materials for finishing coats should furnish protection against air, moisture and water. Several brands of such materials are available, some of bitumastic nature. One of the most common finishes is portland cement plaster, which provides a strong, rigid and smooth finish. On suspended horizontal surfaces, such as ceilings, under sides of ducts and the like, metal lath or mesh should be used. Large pipes, where cork lagged, are either cloth covered or coated with a rubber cement or paint.

Certain manufacturers of insulating materials have definite instructions for the application of their materials which should always be followed, since by so doing the responsibility is theirs.

In addition to the insulation requirements for ducts, apparatus and refrigeration lines, protection must be provided for the steam lines supplying the preheaters, heaters, reheaters, pumps and other steam-driven accessories.

Practically all installations of steam piping from the source of supply to the reducing valve for air conditioning apparatus, carry working pressures under 125 lb. per sq. in. gauge (standard pressure).

The air conditioning system usually operates on steam pressures for heating at from 5 lb. to 10 lb. pressure. For this type of steam system insulation magnesia pipe insulation is satisfactory. The thickness of material is dependent upon pipe size and temperature, or pressure range. The thickness of insulation may be selected from the following table:

Pressure Lb.	Temperature °F.	Thickness, In. Pipes Over 4 in.	Pipes 2 in.-4 in.	Pipes Under 2 in.
Up to 24	212-265	Std.	Std.	Std.
25-99	266-337	1½	Std.	Std.
100-200	338-388	2	1½	Std.

Fittings under 4 in. are usually insulated with hard-finish asbestos cement of a thickness equal to the adjacent insulation. Those over 4 in. are insulated with black insulation of similar material equal in thickness to the adjacent insulation. A type of removable and replaceable flange insulation is obtainable from several manufacturers.

Magnesia covering is finished by neatly sewing cotton duck over the insulation. The duck used is 4, 6 or 8 oz., the 8 oz. being used as a standard in the eastern states. Brass strips are sometimes used to hold the material in place and shape.

Ordinarily, the outside air inlet is insulated with 2 in. cork with ½ in. plaster finish on exposed surface of the insulation. This applies usually for masonry as well as sheet metal construction. The chamber between the outside air louvers and the preheaters, at least, should be insulated, since there is no increase in the air temperature between these points. This insulation is used primarily to prevent condensation on the outside of the chamber during the cold season but, in addition, it eliminates cold exposures in adjacent rooms.

Connections between the preheater and dehumidifier are usually similarly covered.

The dehumidifier is mounted on a layer of 2 in. cork well embedded in hot pitch, and the sides and top are covered with 2 in. cork and ½ in. plaster finish. In this case again the insulation is used to lower heat or refrigeration loss in addition to preventing condensation on the outside surfaces.

When by-pass air is being used, the connections between dehumidifiers and fan, fans, by-pass air chamber, supply and return ductwork are not usually insulated. However, when by-pass air is not used the apparatus connections, fan, and supply duct are usually insulated with either 1 in. or 2 in. cork, plaster finished where exposed.

Acoustics

The question of elimination and absorption of objectionable sounds is complicated but not nearly so bad as many engineers believe.

The problem of keeping the sound level low in ventilating systems resolves itself into three phases: (1) reduction of noise at the source, (2) reduction of transmission of noise from the source to the areas being occupied, and (3) acoustical treatment of the rooms under consideration.

In general, it should be remembered that it is much easier to eliminate the objectionable sounds at the source rather than attempt to reduce the sound level at the room. Points the engineer should consider are the selection of equipment which will operate as noiselessly as feasible without too great an inefficiency or increase of installation cost; location and isolation of the apparatus room to prevent or minimize the direct transmission of noises to occupied rooms; provision for properly designed foundations, supports and flexible

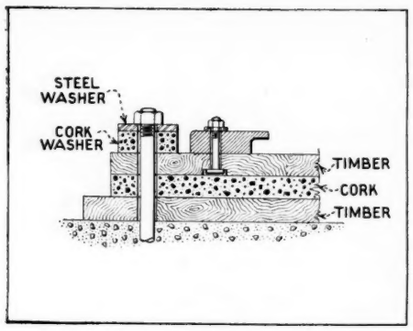


Fig. 1

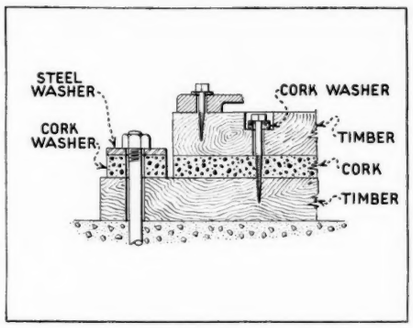


Fig. 2

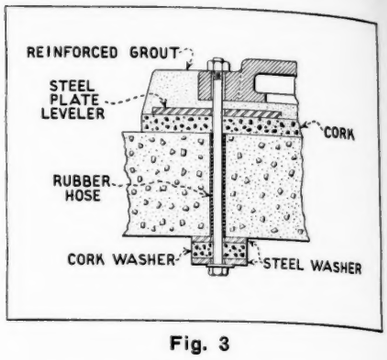


Fig. 3

couplings to prevent vibration from being transmitted through the structural part of the building; provision for suitable sound absorbers in the distributing and return systems to lower the noise level to the proper limits, and acoustical treatment of the room itself to insure the elimination or decrease of other noises.

For ordinary office occupancy it is not necessary to go to extreme refinements in eliminating or absorbing noise in the air conditioning system, since the sound level in the office is generally not low. On the other hand, in a sound picture studio the room itself is constructed so as to minimize all external noises. In such cases the noise from an air conditioning apparatus seems excessively loud, so that provision must be made to keep that noise below the desired level.

Methods have been developed for measurement of sound. A sound wave in the air has two principal characteristics, namely, frequency or pitch, an index of the rapidity of impulses, and amplitude, commonly measured by evaluating the intensity which is the total energy of sound.

The unit of intensity or loudness for sounds is called the decibel, abbreviated as db. A decibel physically is the smallest increase or decrease that can be detected by the ear. Mathematically a decibel may be expressed as

$$10 \log 10 \frac{e_1}{e_0}$$

in which e_1 represents the energy of the sound being measured and e_0 is the energy, representing intensity, which is just barely audible in an absolutely quiet room. Therefore, if one sound is one decibel louder than another, it will be noticeably louder. A 10-decibel increase in loudness represents an increase in intensity of 10 to 1, and a 20-decibel increase in intensity represents an energy increase of 100 to 1.

Apparatus noise, measured at the fan discharge, is usually in the range between 60 to 70 decibels. From this intensity it is necessary to reduce down to the desired level before reaching the room. The following is an index to the amounts of noise readily tolerated in rooms of different occupancy and service:

Sound studios and stages	5 to 8	db.
Radio broadcasting studios	8 to 10	"
Apartments, hotels and homes	10 to 15	"
Theaters	12 to 18	"
Department stores	25 to 45	"
Private offices	10 to 15	"
General offices	25 to 30	"

There are a number of materials commercially available for use in preventing the direct transmission of vibrations of machinery to the building. Although compressed cork, felt, sand, rubber, springs and timber have been used, by far the greater number of sound isolation installations involving air conditioning equipment have been equipped with natural cork foundations. Research has shown that an effective way to prepare this type of foundation is to cut the cork in strips so that the grain of the cork is in a horizontal position when the load is imposed upon it. Inasmuch as no foreign adhesive substances are used to bind the parts together, a steel frame is placed around the foundation. The shock-absorbing qualities of the cork are preserved by dipping the plate (built up of small pieces of cork surrounded by a band of steel) into a bath of heavy, non-volatile oil. This impregnation also serves to make the cork impervious to water, acids and alkalis.

In general, the task of eliminating the transmission of vibration from machines in operation is accomplished in such a manner that the energy of vibration is absorbed by properly fastening the machine to the foundation through a suitable isolating material such as pure cork.

Figs. 1, 2 and 3 are examples of methods of isolating machinery from the floor.

Frequently, the weight of the machine and the suction of the natural cork eliminate the necessity of anchor bolts. However, when such bolts are required,

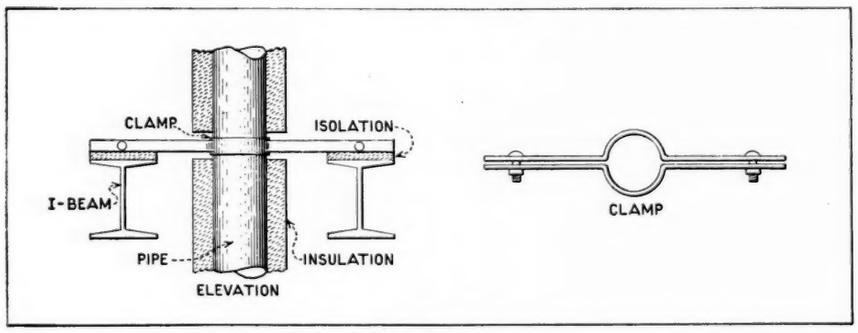


Fig. 4

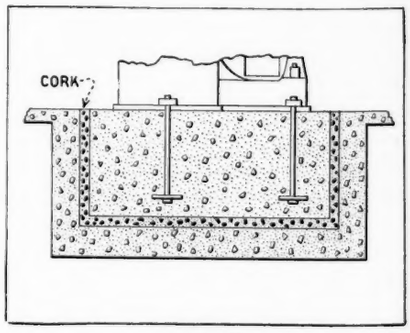


Fig. 5

care should be used to insure adequate isolation to prevent the bolts from touching on solid members of steel or concrete. If anchor bolts are used without being carefully isolated, they may defeat the purpose of the foundation by supplying a direct contact between the machine and the floor.

Fig. 4 shows a method of isolating pipes from walls and floors.

The idea of placing natural cork under the entire base of a machine without calculating to determine the desired loading has been discredited, since the result may be a condition in which the natural frequency of the mass of the machine on its support synchronizes with the fundamental frequency of the vibration of the machine. In such a case the cork foundation will accentuate rather than isolate the vibration. Too much cork is clearly worse than no cork.

Manufacturers of isolating material know the correct loading for a given type of application. For example, to isolate a fan and motor from the floor, the recommended loading for one make of cork (1½ in. thick) is between 2000 lb. and 3000 lb. per sq. ft. of heavy areas. Other machines have different requirements depending on their natural frequency of vibration.

Fan and motor noise transmitted through a duct in an air conditioning system is dependent upon the length, cross-section, and material of which the duct is made. It has been found that long narrow ducts lined with material that is highly absorptive for sound will effectually decrease the noise being transmitted through the distribution and return systems.

Quite often the sound absorbing material is made up in convenient forms for placement in the ductwork. A simple type is made by wrapping some sound absorbing material, such as quilt insulation, around a rigid wire frame. The absorbers may be placed in the duct in solid form, that is, with absorbers adjacent, or in checkerboard form, in which alternate absorbers are omitted.

The absorption coefficient factor is not the only one to consider when selecting a sound absorbing material. Space requirements, cost, sanitation, durability, and fire and water resistance are perhaps more important than using the material with the highest absorbing quality.

Isolation of air conditioning machine rooms and the like may be accomplished by several means dependent upon space conditions and the economic limits prescribed by the owner. Double partitions of masonry materials and hung plaster ceilings may be used with satisfactory results where the generated noise is relatively low. Several trademarked acoustic plasters may be found on the market, most of which are mixed from inert material and a mineral yeast. The yeast causes an expansion of the material and the production of voids resulting in sound absorbing qualities. One efficient sound absorbing medium is made up of metal pans which are pierced with numerous minute holes. The pan is filled with a mat of compressed rock or asbestos wool.

Oil Heating in Orchards

TYPES of oil-burning heaters for orchard heating vary widely. The simplest of these, the so-called "lard pail" type consists simply of a lard-pail shaped container fitted with a cover and holding from 6 qt. to 10 qt. of oil. These burners are lighted on the surface and simply burn from the surface without special ventilation.

They are fairly effective and economical heaters, since their initial cost is low. They have the disadvantage, however, of developing a very dense oil smoke smudge which is extremely disagreeable and very objectionable in a district of dense population.

In heating with oil, in addition to heater equipment it is necessary to provide storage tanks and distribution tanks. A sufficient reserve of fuel for at least two or three nights of heating should be kept on hand at the orchard.

A wholly distilled product sold under the name of orchard heating oil or Diesel oil, varying from 24° to 36° Baume, should be used. It should be practically free from water and asphaltum. The better the grade of oil the less trouble that will develop from smoke and non-burnable residue.

The number of heaters required will depend upon the particular location of the orchard and the minimum temperatures that may be expected. For orchards in southern California under average conditions of low temperatures approximately 50 heaters per acre of the large "smokeless" type will usually be sufficient. At least 100 of the "lard pail" type or briquet heaters per acre will be required.

Approximately 20 gal. of oil per hour of heating per acre will be used when these heaters are lighted. Thus, the oil consumption on a night requiring 5 hr. or 6 hr. of heating will usually run to approximately 100 gal. per acre.

Under these conditions, with favorable atmospheric conditions for heating, it is usually possible to hold the temperatures in protected orchards to from 6° to 8° F. above the temperatures prevailing outside the orchard. This is ample to protect orchards against any but the most severe freezing or frost conditions.

In the deciduous fruit districts of California some orchard heating is done, although the spring frost hazard in those districts in general is not high, and only orchards with relatively poor air drainage are likely to require heating. In the pear orchards of the Rogue River Valley, Ore., heating of the lower lying orchards is general. In the fruit districts of Washington, heating of peach, pear, and cherry orchards is quite general. Apple orchards are heated only where the contour of the land prevents really satisfactory air drainage.

The orchard-heating in these western districts has resulted in relative freedom from frost damage where adequate equipment has been provided and where alert management prevails during the danger season.—*J. R. Magness, Division of Horticultural Crops and Diseases, Bureau of Plant Industry, Department of Agriculture.*

EDITORIALS

Ice

DURING the past few months ice coolers for use in cooling air have appeared in increasing numbers. Until recently ice was thought to stand little if any chance of being used as a cooling medium for comfort work. Many were inclined to dismiss it without consideration. The fact that it had been used in isolated cases for many years was passed over lightly. The mere fact that these coolers are now appearing commercially does not indicate that ice will necessarily come into wide use immediately or universally. It does show though that a better appreciation of the possibilities of using ice is at hand and that the makers of these units recognize that ice is a cooling medium of some merit.

Several ends should be served by the appearance of these apparatus units. First, sales efforts will be made to acquaint users with the merits of ice. Second, the availability of the units will encourage specifiers to consider the use of ice along with the other methods. In the third place the installations made will furnish testing grounds where the factors limiting the use of these coolers can be better studied and understood.

Hot Water

IT is not often that we refer on this page to the subject matter of an article appearing currently in the magazine. In fact, the absence of such comment represents a rather fixed policy. There are times, however, when something so unusual occurs that we cannot refrain from comment. In this issue the concluding part of the descriptive story of the heating and ventilating plant in the new Sixty Wall Tower appears and it embodies so many out-of-the-ordinary features that comment is justified.

In our opinion the use of hot water is the most striking feature. There is nothing unusual about pumping heated water through radiators, but it is unusual to do this in a building of 950 ft. in height and of a size equal to that of this building. Moreover, it is a distinct innovation to do this in modern office buildings in this country. European engineers have been partial to hot water but in this country the use of steam has been so nearly universal that reputable and competent authorities have stated that the high building could not make use of a hot water circulating plant economically. In other words the hot water plant was out of the question in high buildings. Now comes such a plant to confound these opinions. With this installation in existence, and operating, we are not likely to hear for some time that such a plant is impracticable.

The plant is new and the building not yet fully occupied nor has it gone through protracted severe weather. We are, therefore, not in a position to express any opinion as to the ultimate economy or satisfaction which may be obtained in operation. Records are being collected, however, and in due time the story of the results being obtained should be available.

We hold no brief for the use of hot water in building heating. In fact we were as much astonished as others to learn at the time the plans were being prepared that hot water was being seriously considered. We feel that the plant should be looked on as experimental. Our attitude is purely one of "wait and see." It seems to us that all our readers might very well adopt the same attitude. Certainly there is no object in attempting to forecast the results, for they will be made known. If, on the one hand, the installation proves to be highly successful in operation, it is certain to be copied. If, on the other hand, it is not successful, then the reasons for its failure should become evident as time goes on and engineers will know more about the limitations of the use of hot water in such buildings.

We are sure, however, that the story of the mechanical features and of the arrangements made will prove of immediate interest to all. We also believe that all will agree that the originators and designers as well as the owners are to be admired for their courage in undertaking the installation of so unusual a plant.

Building

WINTER has turned into spring and spring into summer while eyes have turned on Washington to learn what constructive measures are to be taken to help the building industry. Of all those which appear promising the home loan bank proposal seems the most likely of securing support, for it is backed by the administration. Prospects for its passage at the present session are still bright. As the weeks pass it seems more and more apparent that no other legislative steps will be taken soon which will directly benefit the building industry. Means of loosening mortgage money and of easing credit are indirect, but no one will deny that they are necessary to promote the resumption of building. It looks as though such measures are about the only ones which can be secured through legislation, and their success is problematical.

While the legislative outlook is thus none too promising, there is one hopeful development from another direction. During the past three months the price index of commodities entering into heating and ventilating has remained steady. This is the first time that the index has failed to fall during a like period for many months. Its steadiness may be taken as an indication that either the stable level has been reached or that further recessions are being resisted. Either is a hopeful sign, for builders can scarcely be expected to go ahead with even necessary and financeable projects in the face of falling commodity prices. Once it is apparent that prices are steady, many planned projects will doubtless move ahead.

Abstracts . . .

Reviews and Summaries of . . . . Current Papers, Books and Pamphlets

Refrigerating Data Book

Fabrikoid-bound book with advertising pages and membership list appended; published by the American Society of Refrigerating Engineers, and obtainable by addressing the secretary at 37 West 39 St., New York; 435 pages; 6 in. x 9 in. page size; price $3.50.

The book is intended as a reference source and is planned for periodic republication. The committee which had charge of the preparation of the book indicates in the preface that it also is expected to serve as a collection of existing information; that the presentation is necessarily brief, and that the usual problems incident to a new publication have had to be met and settled.

The contents are divided into seven principal sections, each of which is subdivided. This grouping seems logical and especially helpful to the infrequent user as the outline is prominently printed on the inside covers. The seven section headings are: Fundamental Data; Principles; Refrigerating Machinery; Insulation and Containers; Refrigerating Equipment; Applications. Included also are the recently adopted code, unit conversion tables and a glossary of refrigerating terms.

A notable feature of the arrangement is that additional references are furnished throughout. This is especially desirable in a book which aims to be a collection of existing information. The reference indexing system adopted, while logical, is not well chosen to assist in rapid finding of references as the key must be consulted in order to learn a reference source and title. The merit of such a plan, which is not in common use in engineering publications, is that it does conserve space and avoids excessive footnoting where references are numerous.

A considerable portion of the data included in the book is not of direct interest to heating and ventilating engineers or contractors, but the sections on air conditioning include data of direct value. The subject is treated in two places — Chapter 5 under the title of Psychrometry, and Chapter 20 under the title of Air Conditioning.

The section on Psychrometry consists of a statement of the principles involved in heat changes of steam and air mixtures. It is a broad and straightforward statement of principles based on accepted laws and treats the mixtures as such. It contains no new material (and this is as it should be, for no new principles are necessary in treating the subject), but is handled in a fashion which is distinctly refreshing.

The chapter on Air Conditioning is brief and written in a detached style which is in itself convincing. In only one or two cases does the text as written lead to the thought that perhaps its writer has personal convictions which are being allowed to slip in. On the other hand he has a knack of evaluation, and is frank enough to label practices as such. The description of the by-pass system and the solution of a problem involving its use are clear and meaningful. This chapter is without doubt the best published short but comprehensive description of the currently practiced applications of air conditioning which has appeared to date. It would be well worth the while of any engineer interested in air conditioning to follow through this chapter.

The book as a whole is well set up, shows the unmistakable marks of careful planning and editing, and is a welcome addition certain to grow and improve with time.

●

American Heating and Ventilating Practice

By Karl R. Rybka

Cloth-bound; illustrated; appears under its German title of "Amerikanische Heizungs- und Luftungspraxis" and in German text; obtainable through Julius Springer, Berlin; 174 pages; 6¼ in. x 9¼ in.; price RM. 18.

The author has taken much of the American data and has changed it into corresponding German units and interpreted it in terms of German practice. In some cases he compares our practices with those current in Germany. One must be able to follow the German text, and to those able to do so the book is an interesting commentary on some of our practices.

●

Central Heating by Electricity

By D. Winton Thorpe, A.M.I.E.E.

From "World Power"; Part I, January, 1932; Part II, April, 1932; seven illustrations, including one chart; 6000 words.

Contains arguments for central heating, which the author defines broadly as any system of heating in which the central source of heat is common to a large number of heating points, versus heating with boiler or furnace. The three types of electric heating appliances coming under this head and listed in the order of their efficiency are: warming panels, electric tubular heaters, and glowing coils, etc.

The author states that heating by electricity requires a great deal less space, since the boiler room and fuel storage space, as well as distribution apparatus and chimney, are eliminated. Another advantage cited by the author is the immediate control of the heat given off at an individual heating point when the heat is dispersed by true radiation electrically produced and controlled. The economy effected by the consumption of fuel only is needed, and by the reduction of time required for heating up and cooling down is pointed out.

It is the author's opinion that convected heat is not the most hygienic, and also has the disadvantage of producing smears on walls and ceilings where convection currents impinge. Radiated heat travels in any direction in which it is projected so that the heaters may be taken from the lower portion of the room and placed near the ceiling where they do not interfere with furniture.

Warming panels are advocated as the most efficient and effective means of carrying this out. They may be mounted flush with the surface of the wall or may be projected by their own thickness. Also they may be mounted on brackets or suspended from the ceiling in any position. Some convection results from wall mounting but, with one type of bracket mounting, the radiated portion of the heat has reached 80%.

The second part is entirely devoted to a study of installation and operating costs for tubular heaters. All standards are British, and comparisons would be difficult. No reference is made to cost of power, and there would be no convenient method of converting his figures to ours. He does conclude, however, that electric heat is cheaper than individual plants.

●

General Engineering Handbook

By C. E. O'Rourke

Fabrikoid-bound book; illustrated with curves and charts. Published by McGraw-Hill Book Co., New York; 921 pages; 5 in. x 7¾ in. page size.

This book, which is prepared in the usual handbook style, is the work of Professor O'Rourke and a staff of associate editors. It is arranged in 31 sections, each of which deals with a principal part of one of the four general divisions of general, civil, mechanical and electrical engineering. With this plan much useful data from these important fields of engineering are concentrated into one set of covers which should add to the usefulness of the book, making it valuable as a common source instead of necessitating reference to a book in each field. The practice of supplying additional references to each subject is used, and while the book is necessarily brief in some of its sections this plan overcomes its lack of detailed completeness in each subdivision. A carefully prepared index makes the use of the book easy. Our readers will be particularly interested in the sections devoted to mechanical engineering which occupy slightly over 200 pages.

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The Measurement of Radiant Heat in Relation to Human Comfort

By H. M. Vernon, M.D.

Journal of Industrial Hygiene; March, 1932; 5000 words; two tables, curves, and photographs of apparatus.

Contains a record of extensive investigations conducted by the author to determine the parts played respectively by radiation and convection in warming the human body. He has devised a means of summating all the radiation effects received at a given spot, by the use of a globe thermometer.

The most practical form of globe thermometer devised for this purpose consists of a 6-in. sheet copper sphere, painted mat black, into which a thermometer is inserted, with its bulb at the center of the globe. The thermometer reading is an indication of the combined effects of convection and radiation on a human body, subjected to the identical influences. The excess of the globe temperature over the air temperature constitutes the *effectual radiation temperature.*

A series of tests was made, with the author and an assistant as subjects, to compare the effects of radiation from a gas fire, an anthracite stove, and ceiling heating panels. During the tests, effort was made to maintain atmospheric conditions so as to produce a sensation of comfort. Then by the use of a system of numbers to denote the degree of sensation of warmth, it was found that an increase in atmospheric temperature required a corresponding decrease in effectual radiation temperature, in order that a constant sensation of comfortable warmth might be maintained. Thus, when atmospheric conditions were such as to induce a sensation of comfortable warmth, the globe thermometer indicated approximately 62° F., although the air temperature varied from 49.3° to 61.7°, and the effectual radiation temperatures from 12.8° to 0.4°.

It was found that the stove had approximately one-third the radiating capacity of the gas fire, and that the ceiling panel radiation capacity was approximately one-third that of the stove.

Increased air velocity greatly reduces the effectual radiation temperature. An air current moving at 270 f.p.m. lowered the radiation of the gas fire to one-half and that of the stove to one-third of the observed radiation in still air.

It is demonstrated that ceiling panels heated to 100° have an effectual radiation temperature of a little over 1°, but that small overhead heaters at 500° have a radiation temperature of 6° when spaced 9 ft. apart. The author suggests, in conclusion, that a system of panel heating inducing an effectual radiation temperature of 2° or 3°, with an increase in ventilation to keep the air at a reasonable temperature, and with a slight concentration of panels in one end or side of the room, might prove the most satisfactory.

●

Smoke—A Study of Aerial Disperse Systems

By R. Whytlaw-Gray and H. S. Patterson

Cloth-bound; illustrated; published by Edward Arnold & Co., London, and obtainable through its United States agents, The Engineers Book Shop, New York; 192 pages; 6 in. x 9 in.; price $4.50 plus postage.

The unusual feature of the book lies in the point of view taken by the authors. They consider smoke as an aerial disperse system and as being of the same nature as clouds and fog and suspended dusts. Smoke, according to this view, includes all those aerial disperse systems which consist of particles of low vapor pressure and which settle slowly by gravity, except those considered as fogs and dusts.

The book reviews the methods of measurement of smoke and includes some new data recently developed.

It also summarizes, and suggests the lines which future studies should take.

The book, being written from a chemical engineering method of approach, is scarcely understandable to engineers whose interest in smoke is largely that of prevention. It will, however, appeal to the smoke specialist who is interested in the fundamentals and who is more likely to appreciate the necessity of establishing dependable measuring methods than is his co-worker who is concerned with preventing unlawful concentrations of smoke.

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Development of a Direct Contact Water Heater

By L. A. Scipio

Research Series No. 38, Engineering Bulletin of Purdue University; paper bound; illustrated; obtainable by addressing Engineering Experiment Station, Lafayette, Indiana; 50 pages; 6 in. x 9 in.; 35 cents.

The author describes his procedure in developing a gas-fired apparatus for use in heating buildings with hot water and wherein the burned gas is brought into direct contact with the water. During the course of his work he found it necessary to revamp his apparatus several times. He states that the following conclusions may be drawn from his investigation:

1. The products of combustion resulting from the burning of gas may be mixed directly with water and have their temperature reduced to practically that of the water being heated.
2. The latent heat of water formed during the burning of gas may be conserved by mixing the gases of combustion with the water being heated.
3. When the hot gases are mixed directly with the water being heated, *the thermal efficiency of the heater is based upon the gross heating value of the gas.* There is, therefore, an increase of economy of operation amounting to about 10% over what would result were the net heating value taken as a basis.

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A Simple Method for Determination of Ozone in Ozonated Air

From "Einfache Methode zur quantitativen Bestimmung von Ozon in ozonisierter Luft," by R. Krais and H. Market; Angewandte Chemie; No. 11, March 12, 1932; 750 words.

Describes the method followed with success at the Dresden Textile Research Institute for investigating the performance of an ozonizer.

Two Erlenmeyer flasks are required. One of these should be of 2 liter and the other of 500 cc. capacity, having their necks ground together to form a tight fit. The larger flask has an air inlet and an air outlet tube ground into it. A steady flow of air is obtained from a small air pump and a gasometer. The ozone generator must be tight and is provided with a gas inlet and outlet. Cork joints are recommended as ozone rapidly attacks rubber tubing.

A small amount of 0.1% potassium iodide solution (the exact quantity is determined by preliminary experiment) is placed in the 500 cc. flask, along with 5 cc. of a 1.0% soluble starch solution, and this is covered with about 400 cc. of water. These should not be mixed.

A uniform stream of measured magnitude is passed through the ozonizer and thence through the larger flask, which is dry. This flow is continued for a period depending upon the volume of flow, 10 min. being given as sufficient for a flow of 3 liters per min. At this time the gas connections are withdrawn without interrupting the air flow, the two flasks fitted together, and the contents of the flasks agitated by shaking for 5 min. or so. During this agitation, the ozone is absorbed and the starch assumes a blue color. When the reaction is complete as indicated by the absence of ozone odor, the solution in the flasks is acidified by the addition of a small quantity of dilute sulphuric acid, and the iodine is titrated. One liter of thiosulphate corresponds to 0.24 grams of ozone, and since the magnitude of the air stream is known, the ozone content can be readily computed.

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Solid Fuels and Their Use in Hand-Fired Plants

Educational Bulletin No. 4 of the Committee of Ten, Coal and Heating Industries; mimeographed; paper-covered; obtainable by addressing the secretary, Chicago, Ill.; 31 pages; 8½ in. x 11. in.; price 25 cents.

This pamphlet is a collection of information from numerous sources, and the material has been classified and is presented under six sections as follows: The Heating Plant and its Care; Hand Firing Domestic Plants; Trouble Shooting; Hand Firing Low Pressure Heating Plants; Terms and Definitions; Classification of Solid Fuels. The pamphlet also contains a bibliography of 24 titles.

●

A Digest of Law and Cases on Heating Systems and Devices

By S. A. Raboy

Mimeographed and paper-covered loose-leaf book; unillustrated; published by the American Oil Burner Association, New York; 360 pages; 8½ in. x 11 in.; price $10.

While published by the oil burner organization, the book is really a digest of many legal aspects of the whole field of heating. The method used is to present a discussion of the legal principles and then to cite cases. Although many of the examples of application are to oil burner situations, still the same essential conditions arise in the case of other devices and the same principles would apply. For this reason, and because of the extent of the material, the book is of interest to all manufacturers, dealers and contractors engaged in heating. It is believed to be the most comprehensive work of its kind which has been undertaken.

The chapter headings are as follows: Contracts; Fixtures; Insurance; Mechanics Liens; Municipal Corporations; Negligence; Nuisance; Patents; Sales; Trademarks. A comprehensive index is included.

Your Everyday Problems

Mr. Hanburger will be glad to answer your problems relating to installation and operation of heating and ventilating systems, and wherever possible will give the reasons for his suggestions. Letters will be answered direct to the inquirer and in some cases published anonymously. If sketches are included they should be clearly drawn. Write Mr. Hanburger, HEATING AND VENTILATING, 148 Lafayette Street, New York.

Conducted by FRED W. HANBURGER

QUESTION 49. I have a condition where all the radiators in the system become waterlogged excepting those on the extreme riser. I suspect that it is a leaking radiator trap for the reason that all the piping is of ample size. How can I locate it? G. L.

ANSWER. It is generally possible to locate this during a firing-up period by noting the temperature of the return piping at each radiator. The leak should be particularly noticeable in this case where it is so great as to fill all the return mains with steam.

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QUESTION 50. I have both copper and cast iron radiation on the same heating system, but am having a little trouble with the thermostatic control. The manufacturer of the copper radiation tells me that I should use one kind of radiation throughout. H. A.

ANSWER. The internal capacity of the copper radiation in general is much less than that of the cast iron type, therefore, when the thermostatic control closes the system, the copper radiators cool off more quickly than those of cast iron, and the temperature of the room of course will fall. However, as the emissivity of the copper is greater than that of the cast iron, the room will heat more quickly after the valves are again opened.

Possibly there are other factors involved. I am gathering data on this subject and may be able to give you further information later.

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QUESTION 51. A says that there is a greater friction loss in the pipes for vacuum steam than there is when low pressure is used. B says that this is not the case because smaller pipes may be used for vacuum systems. Will you kindly discuss the question? J. R. T.

ANSWER. Both are right, therefore all bets are off. There is a greater friction loss for the lighter steam when the same weight of steam is passed through the pipes, but less friction loss when the same volume of the lighter steam is taken. There are numerous charts that give the friction loss for steam at varying densities. The ones generally used in heating are for steam at from 2 lb. to 5 lb. pressure per sq. in. The thought might be brought out more clearly if we take the general formula

$$P = \frac{D\pi L K V^2}{A}$$

where K is a constant which embodies the density of the steam.

Now, in the second case, taking steam that is but half as heavy as in the first case, K, and consequently P, would be decreased one-half, but to supply the same amount of steam by weight, the velocity would need be doubled for the lighter steam and as the pressure—or friction—increases as the square of the velocity, the pressure must be increased four-fold. Combining the two factors the result will be a double friction loss for the same weight of the lighter steam.

This is not precisely so, but sufficiently accurate for practical results, and in ventilating work it is so accepted and the friction is taken as varying with the absolute temperature. With the older type of vacuum systems where the vacuum was carried throughout the entire system, smaller pipe could be used owing to the fact that there was a much greater pressure differential which allowed a greater friction loss. Where traps are used this differential exists throughout the piping only when the traps are passing condensation, but at all other times conditions are the same as in standard low pressure heating.

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QUESTION 52. I have in mind a heating system designed for forced hot water in which the water is circulated by a 1500 gal. pump and heated by an H.R.T. boiler rated at 125 hp. The temperature rise of the water in passing through the boiler is 20° (160° to 180°).

If we use the accepted value of 34.5 lb. of water evaporated from and at 212° per boiler horsepower, we obtain a value of 125 × 34.5 × 970.4 = 4,184,850 B.t.u. per hr., the heat equivalent of 125 hp.

The heat imparted to the circulating water by the boiler equals 1500 × 60 × 8.1 × 20 = 14,580,000 B.t.u. per hr.

My explanation for this difference in heat values is that it is due to the increased rate of circulation in the boiler and to the fact that the temperature difference between the circulating water and the furnace gases is much greater than would be obtained if the boiler were operated for steam generation.

I shall appreciate receiving your comments on the above conditions and also any information regarding the rating of power boilers for forced hot water heating service. Since the rating will depend on the condition of the boiler, let us assume that it will receive first-class attention and will be cleaned every year. M. S. T.

ANSWER. It is somewhat difficult to reconcile the amount of heat which the 125 hp. boiler can deliver and the amount that is apparently consumed by the

system. In fact, there must be a discrepancy somewhere which no doubt lies in the fact that the system itself does not consume as much heat as it is supposed to do, namely, 1500 gal. of water per min. heated through 20° and requiring 14,580,000 B.t.u. Possibly a better way of viewing it would be by the grate area of the boiler and the amount of coal consumed. Thus, 125 hp. is equal, as you say, to 4,184,850 B.t.u., and taking 8,000 B.t.u. as a fair average obtained from 1 lb. of coal we obtain

$$\frac{4,184,850}{8,000} = 523 \text{ lb.}$$

of coal per hr. The grate area is sufficient to burn this amount of coal and it would be manifestly impossible to burn over three times this amount which would be required to heat the water through the stated temperature rise.

It is very likely that the water is returning at a temperature higher than 160°, or it is not being heated to 180°, or again that the pump is not delivering 1500 gal. per min.

It would be of interest to know the estimated heat loss of the building or buildings being supplied by the installation.

Due to the fact that the temperature of the water in the boiler is less than it would be if steam were being generated, we have a slightly higher heat transfer and the flue temperature will naturally be somewhat less, but the increased efficiency would be only a small fraction of what the two given figures indicate.

●

QUESTION 53. Thank you for your past assistance in our departure into the ventilating field. In reading up on the subject I can understand the formula

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

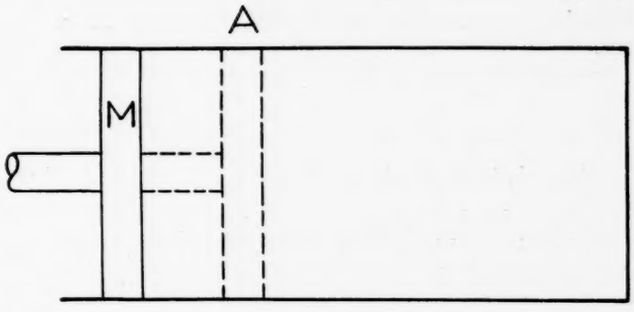
since when the pressure is increased the volume will decrease accordingly if the temperature remains the same, but the temperature does not stay the same. For instance, if we take a cylinder holding 10 cu. ft. of air at 70° and compress it to 7.5 cu. ft., or three-quarters of the original amount, the pressure will be greater than

$$\frac{4}{3} \times 14.7 = 19.6 \text{ lb. per sq. in.}$$

because the air becomes hotter under pressure. How can I tell what the temperature and pressure will be under this condition? *E. L.*

ANSWER. Whenever we suspect that there is a nigger in the woodpile the best thing to do is to tear the woodpile apart and look him up. The one that is causing all the trouble in this case lies in the fact that gases have two different specific heats, one at constant pressure and one at constant volume. Thus, the specific heat of air at constant pressure is 0.24, and at constant volume 0.171.

With the use of the general formula alone it would be impossible to determine the resulting pressure and temperature when 10 cu. ft. of air are compressed to 7.5 cu. ft., so that it is necessary to determine this otherwise, and we may then use the formula to verify our findings.



In the accompanying drawing the cylinder has a volume of 10 cu. ft. and a freely moving piston M. Let the temperature and pressure both outside and inside of the cylinder be 70° and 14.7 lb. per sq. in.

If we now extract sufficient heat from the air in the cylinder so that it will contract to 7.5 cu. ft., the piston M will move to the point A, due to the outside air pressure, thus keeping that in the cylinder also at 14.7 lb. per sq. in.

As the volume of the gas varies with the absolute temperature, or

$$\frac{V_1}{T_1} = \frac{V_2}{T_2} = \frac{V_x}{T_x}$$

and as the absolute temperature of 70° air is

$$460° + 70° = 530°$$

we have

$$\frac{10}{530} = \frac{7.5}{T_2}$$

when $T_2 = 397.5°$

The amount of heat extracted must be based upon the specific heat of air at constant pressure since the pressure is remaining the same at all times. This specific heat as mentioned is 0.24. As the weight of 10 cu. ft. of 70° air is

$$10 \times 0.075 \text{ lb.} = 0.75 \text{ lb.}$$

the amount of heat extracted would be

$$(530\text{-}397.5) \times 0.75 \text{ lb.} \times 0.24 = 23.85 \text{ B.t.u.}$$

If we now lock the piston at A to keep the volume constant at 7.5 cu. ft. and again introduce the heat which we have extracted, the temperature will rise. Since the specific heat of air at constant volume is 0.171, we have

$$\frac{23.85 \text{ B.t.u.}}{0.171 \times 0.75 \text{ lb.}} = 186°$$

giving as the temperature of the air

$$397.5 + 186 = 583.5° \text{ absolute, or } 123.5°.$$

As the pressure varies with the absolute temperature or

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

we have

$$\frac{14.7}{397.5} = \frac{P_2}{583.5}$$

when

$$P_2 = 21.6 \text{ lb. per sq. in.}$$

We can now go to the original equation

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

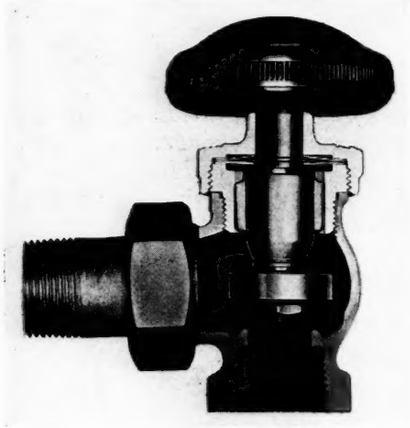
and substituting these values, we have

$$\frac{14.7 \times 10}{530} = \frac{21.6 \times 7.5}{583.5}$$

New Equipment

Marsh Bonnet Assembly

Jas. P. Marsh Corp., Chicago, has introduced the Type R bonnet assembly, a unit for replacing worn out and obsolete radiator inlet valve equipment. Units are available to fit all standard makes of packed or



Radiator valve replacement unit

packless valves, and installation is made by inserting the unit in the old valve body and turning the nut up tightly. No machining, reaming, or fitting is necessary.

Two sets of thin metal discs form a positive packless sealing arrangement. The valve is quick opening and has a high lift to permit nearly full pipe-size flow capacity when the valve is opened wide.

Airco Air Conditioning Units for Homes

Conditioned Air Corp., Ford Building, Detroit, is manufacturing the Airco air conditioning unit.

Air is drawn from the residence through a grille, and is passed into the unit which is located in the basement. In summer the air is forced through a series of sprays which cleans and purifies it, after which it is passed over coils for cooling and dehumidification. In winter the air is washed and cleaned in the sprays and moisture added in the humidifying chamber. The air is passed through a filter for removal of dust and dirt before being recirculated into the living rooms. Units are automatically controlled by a humidistat in the winter and by a reverse thermostat in the summer, which maintains the desired reduced temperature. Moving parts are confined to a fan, motor, and condenser, and all operations are automatic, no attention being required by the owner.

Humidifying capacity is said to be 150,000 cu. ft., and the device will cool 5000 cu. ft. of space.

Bishop and Babcock Furnace Blower

An insulated furnace blower unit has been announced by The Bishop and Babcock Sales Co., Cleveland.

Complete assembly, including fan, motor, and filters are combined into a single unit and enclosed in a flake-aluminum-finished celotex casing which is said to be soundproof. The motor drives the fan through a belt, and variable speed is attained by means of an adjustable pitch motor sheave. A removable rear panel gives access to the working parts and the filters. No assembling is required on the job when installation is made, and duct connections are made directly to the unit. It is unusually compact.

Four sizes of blower are made, and maximum discharges vary from 1000 c.f.m. to 4000 c.f.m.

Northern-Breeze Room Cooler

Chicago Pump Co., 2336 Wolfram St., Chicago, is manufacturing the Northern-Breeze room cooler. The device is portable, and is recommended for use in homes, offices, small stores, and similar applications.

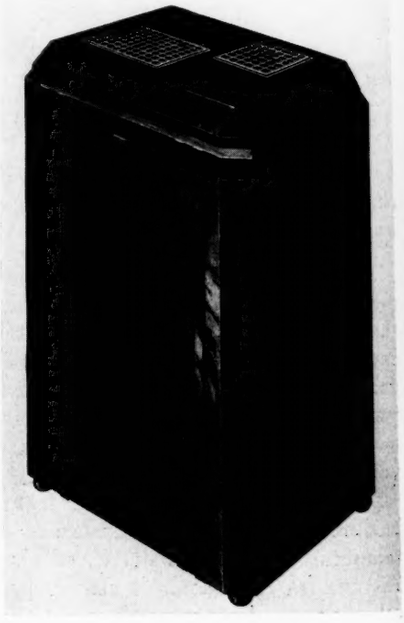
Ice is the refrigerant used. It is charged in at a door in the upper rear of the cabinet, and a tank in the bottom holds a capacity of 300 lb. A motor-driven pump circulates water in contact with the melting ice through a heat-exchange coil at the top of the enclosure. A fan, driven by the same motor as the pump, draws air in at the grille to the right and, after passing it over the coil, discharges it back into the room through the left-hand grille. Contact with the coil cools the air and condenses out the excess moisture. The air is also washed in passing over the wet coils. It can be used as a humidifier.

York Utility Air Cooler

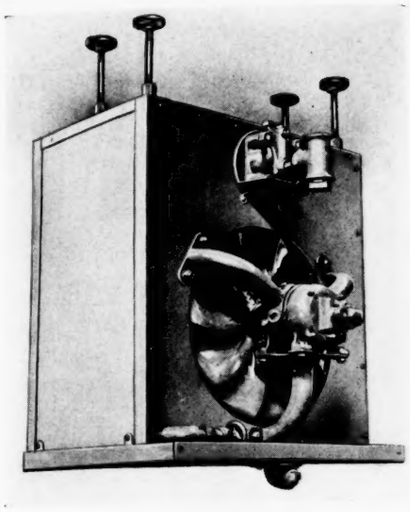
York Ice Machinery Corp., York, Pa., is manufacturing the York utility air cooler. Either direct or indirect refrigeration may be used, and it may be connected to a single mechanical refrigerating unit or to an existing central system. It is suited primarily for offices, stores, and storage spaces.

An electrically-driven fan in the rear of the unit provides circulation of air past the cooling element and discharges it through the front of the device. Chromium-plated adjustable louvers in the air outlet serve both to direct the air circulation and eliminate entrained moisture.

Automatic control of room temperatures is accomplished by thermostatic regulation of refrigerating machine operation, or where the unit is connected to a central refrigerating system, by thermostatically regulating the flow of the refrigerant. The fan is kept in continuous operation to maintain circulation and even temperature distribution.



Northern-Breeze cooler

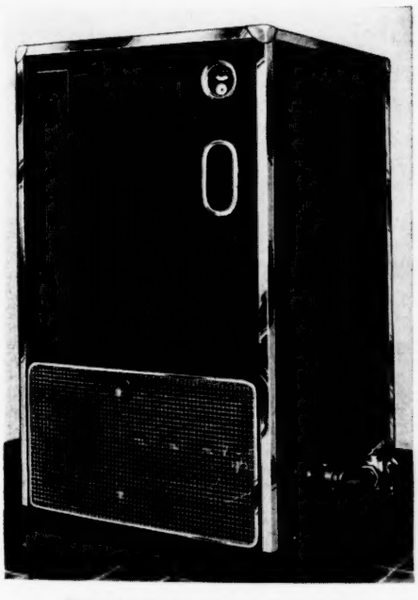


Rear view of cooler

Units are enclosed in heavily lacquered steel casings, the sides, top, and bottom of which are of No. 16 gauge, and the front and rear panels of No. 14 gauge. Louvers are protected with a chromium-plated wire grille, removable for cleaning and adjustments. A drip pan with drain connection extends under the entire cooler. Four flanged hanger bolts directly connected to the coil stands suspend the unit from the ceiling.

Burnham-Simplex Gas Boilers

Burnham Boiler Corp., Irvington, N. Y., has introduced the Burnham-Simplex gas boiler, designed for use with any steam or hot water heating system. It is also recommended for large volume hot water supply and low pressure steam for industrial work.



Burnham-Simplex gas boiler

Intermediate boiler sections are of cast iron external water tube construction. The flue ways are venturi-shaped and in combination with extended surfaces provide for rapid absorption of heat with minimum resistance to flow of the products of combustion. End sections are of internal water-tube construction, with extended waterlegs.

Burners are of the Bunsen type, having raised ports and venturi mixers, and are supplied in styles expressly designed for the kind of gas to be used. Ignition is secured by a thermostatic pilot having a bunsen-type flame, and which closes the gas supply should the pilot be extinguished. A valve controlled by a room thermostat shuts off the supply of gas to the boiler when the desired temperature in the living quarters has been attained. This control may be effected manually in the event of current failure. Steam boilers are equipped with steam pressure regulators and low water cut-offs.

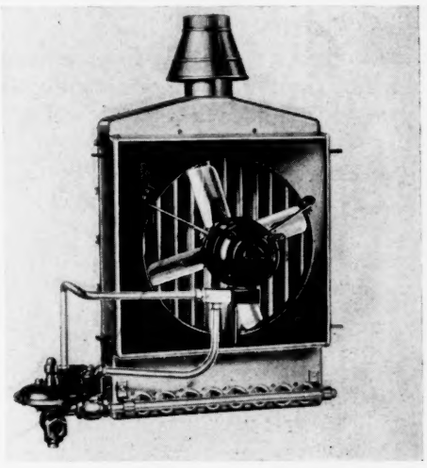
Units are enclosed in a rust-resisting steel jacket having a baked enamel finish, and backed with air-cell insulation. Capacities range from 185 sq. ft. to 3750 sq. ft. of direct radiation for the steam boiler, and from 300 sq. ft. to 6000 sq. ft. of radiation for the hot water boiler.

Continental Gas-Fired Unit Heater

Continental Stove Corp., Ironton, Ohio, is marketing the Continental 100 gas-fired unit heater, recommended for industrial and commercial use.

Heating element tubes are expanded into plates, insuring a gas-tight joint and permitting expansion and contraction of the metal. Tubes are full size the entire length and have a smooth surface inside and out. A multiple of small burners of the gravity type are used in this heater in preference to a few large ones to secure greater combustion efficiency.

A safety pilot is provided which operates through a mercury switch and a solenoid valve to close off the gas supply should the pilot light fail. The inlet for secondary air is covered with a fine mesh screen and the entire combustion chamber is sufficiently close-fitted to prevent ignition of any combustible vapor from without. The fan is driven by a ⅛ hp. split-phase induction motor as standard equipment, but a suitable motor for any current supply can be had as specified. At a fan speed of 1150 r.p.m. the air velocity is 708 f.p.m., the volume 2000 c.f.m., and the temperature rise 45° over room temperature. Louvers are adjustable to direct the air discharge as desired. The heater is 44 in. high, 21 in. wide, and 24 in. deep.



Continental gas-fired unit heater

Furnace Temperature Control

Heatset is the name of a furnace temperature control manufactured by the Automatic Humidifier Co., Cedar Falls, Iowa, and distributed through the Automatic Humidifier Sales Co., Detroit.

A tilting arm mounted on the side of the furnace is actuated by a thermostatic element projecting inside the heater to regulate the drafts. The device is set to operate at any desired temperature by means of a chain extending into the living rooms.

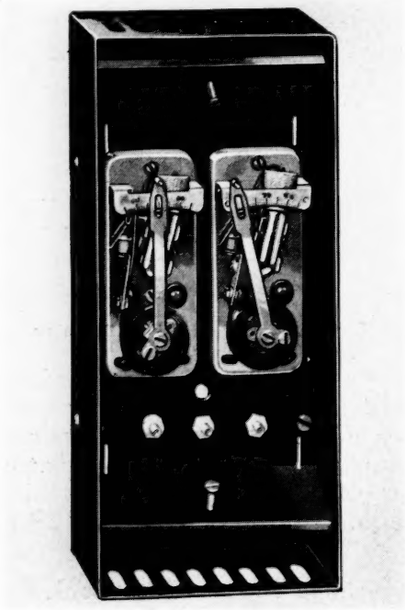
Oxweld Regulators for Oxygen and Acetylene

Two regulators have been added to the line of welding equipment manufactured by the Linde Air Products Co., 30 E. 42nd St., New York. These are designated the Oxweld Type R-48 oxygen regulator, and the Oxweld Type R-49 acetylene regulator, and provide a pair of lighter duty regulators, partic-

ularly for use with the Type W-15 welding blowpipe in the sheet metal welding outfit.

Infiltration Thermometer Controls Temperature from Cold-Wall Side

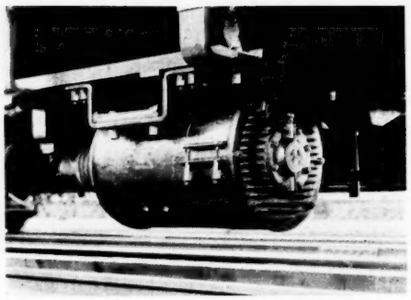
A thermostat which establishes the comfort zone at a level nearer to the floor than is conventional practice has been developed by J. C. Hornung, engineer, Central Heat Appliances, 343 S. Dearborn St., Chicago. The device is called an infiltration thermostat.



Infiltration thermostat

Mounted on the cold-wall side of the room, at about radiator level, the thermostat is actuated by infiltration of the so-called effective cold, a combination of wind effect and heat lost through the wall, at the principal source of temperature change. It is said that regulation at this point results in maintenance of the room temperature at a uniform level and eliminates time-lag.

This maintenance of an even room temperature eliminates over-heating and under-heating, thereby instituting increased economy in fuel costs. It is also said by the manufacturer of the device that the infiltration thermostat promises to further advance and perfect zone or group heating.



Third brush generator for railroad air conditioning equipment

Fairbanks-Morse Railroad Air Conditioning Equipment

Motors and generators designed expressly for a railroad passenger car air conditioning equipment have been developed by Fairbanks, Morse & Co., Chicago.

Generators are driven from the car axle and are of the third brush type, having a nearly flat voltage characteristic over a wide range of car speeds. Cast steel frames and housings are used on the generators in order to secure minimum weight and diameter consistent with strength requirements.

A low voltage system is used throughout in order to avoid interference with the usual car lighting system, and each car is independent of the others for flexibility of operation. A large storage battery reserves sufficient capacity for approximately 1½ hr. operation for precooling.

Fisher Fre-Flow Strainers

Fisher Governor Co., Marshalltown, Iowa, is manufacturing the type 260-Y Fre-Flow strainers, for removing dirt, pipe scale, or other foreign material from pipe lines carrying air, water, steam, gas, or oil.

A large screen area makes possible a full flow through the device, with a minimum of pressure drop. The screen is renewable, and is self-cleaning through the blow-off connection, which should be installed and furnished with a small globe valve. Lap-welded perforated bronze screens are regularly supplied with perforations of 1/64 in. for air and gas, and 1/32 in. for water and other liquids.

Strainers are obtainable with either semi-steel or bronze bodies and have screwed connections, the semi-steel bodies having a hexagonal shoulder at the inlet end. They are manufactured in sizes ranging from ¼ in. to 2 in. and may be used with pressures up to 250 lb. and a maximum temperature of 500° F.

Buckwheat Burner for Domestic Heaters

International Heater Co., Utica, N. Y., has introduced the Buck-Burn blower, a small fan to be attached to the ash-pit door of a heater to increase the draft.

Use of the blower makes possible the burning of finer grades of coal which are less expensive than the larger sizes. It is also convenient as a booster to the natural draft in igniting a fresh charge of fuel or in starting up the fire. When used in conjunction with a room thermostat and a safety limit switch, the blower will serve to regulate the fire to conform to the heat required, and reduce necessary attention to a minimum.

To install the device, a hole is cut in the ash-pit door through which the blower outlet projects into the space below the grate. A flexible cable connects the motor to the switch and current supply to allow the blower to swing with the door when it is opened for ash removal. A damper on the outlet prevents ash dust from escaping through the blower when it is not in operation,

Buck-Burn blower

and to prevent infiltration of air when no draft is desired. The standard motor is of the 110 volt, 60 cycle induction type, requiring an input of 40 watts. Motors for use with other power supplies can be furnished if specified.

Long Radiators

W. T. Walsh has not been appointed distributor for the radiators being manufactured by the Long Manufacturing Co., Detroit, Mich., subsidiary of Borg-Warner Corporation, as stated in the June issue.

Klenzair Portable Air Washing and Cooling Fan

A portable air washing fan has been introduced by The Swartzbaugh Mfg. Co., Toledo, Ohio. It is called the Klenzair, and is for domestic, office, small store, and similar uses.

Air is passed rapidly through the device, where it is subjected to four sprays of finely atomized water which wash and humidify it. The driving motor is of the 60-cycle shaded pole induction type, and draws 44 watts power. The motor is fully enclosed to prevent the entrance of water. The fan is 7½ in. in diameter, and has monel metal discs and aluminum blades. A switch and rheostat provide for low and high speed operation. The fan discharges 6000 cu. ft. of air per hr.

Air washing fan

Fulrange wrench with fittings it will handle

Fulrange Pipe Wrench

A new chain pipe wrench called the Fulrange, has been placed on the market by the American Industrial Corp., 230 Park Ave., New York.

Pipe is gripped at the front of the wrench rather than on the side, a feature which makes it possible to use it in restricted locations. The tool is reversible, and can be operated in either direction without removing the pipe or adjusting the chain. Ratchet action is provided. The No. 1 size will handle pipe from ⅜ in. to 1½ in. together with all fittings for pipe in this range.

Koolair-Maker Portable Air Conditioner

A portable air conditioning unit has been announced by Koolair-Maker Corp., 4485 Olive St., St. Louis, Mo. The device will cool in summer and heat in winter, and will control humidity in both cases. It is designed for home, office, or store use.

Cooling is effected by circulating air over a coil through which cold water is passed, by subjecting it to a spray of cold water, or by a combination of both methods, according to the humidity requirements. The cold water may be supplied either directly by block or cracked ice charged into the cabinet, or by mechanical refrigeration. A charge of 300 lb. of ice may be loaded into the device, and this is said to be sufficient for from 8 hr. to 14 hr. of cooling. The temperature in a room of 3000 cu. ft. may be lowered by 10° to 18°.

Steam or hot water is used in the coil for heating in cold weather. The cabinet is 50 in. long, 46 in. high, and 15 in. wide, and is finished in Burl walnut on steel. It is mounted on four rubber-tired casters. Units can be supplied for operation on any desired alternating or direct current voltage.

Carrier Ice Room Cooler

A compact portable air cooling unit using melting ice as the cooling medium has been developed in the Carrier Research Laboratories, Newark, N. J. It is designed for use in offices, small stores, shops, restaurants, and wherever the central type of air conditioning installation is too large for the requirements.

Carrier portable room cooler

Units are enclosed in mahogany-grained steel cabinets on wheels. The units are 51 in. high, and 24 in. in width. Three hundred pounds of ice are charged into it, this quantity being sufficient for about 5 hr. cooling during hot weather. A small electrically-driven blower operated from a light socket circulates air over the ice and the metal grids upon which it rests, and discharges it back into the room through openings in the top of the cooler. Contact with the ice and the cold metal surfaces both cools and dehumidifies the air. The amount of cooling and the direction of air delivery can be regulated by adjusting shutters in the outlets.

Capacity is 400 cu. ft. of air per min., and it is said to reduce the temperature of a room by approximately 10°.

New Equipment

Baldor Capacitor Motor

A capacitor motor designed particularly for noiseless driving of oil burners, stokers, air conditioning apparatus, and other household applications, has been announced by Baldor Electric Co., St. Louis, Mo.

Rotor is of the squirrel cage type, dynamically balanced to eliminate vibration. A smooth and quiet switching device gives quick and noiseless starting. Sleeve bearings are machined out of phosphor-bronze stock, and housings are wool-packed and will retain sufficient lubricant for one year of operation. The motor is mounted on a spring cushion base which is noise absorbent, and at the same time rigid, giving uniform mounting dimensions.

American Air Filters

Two air filters, designed particularly for warm-air heating systems, air conditioning units, room coolers, and unit ventilators have been announced by the American Air Filter Co., Inc., 215 Central Ave., Louisville, Ky. Both types utilize filtering mediums fabricated of split wire woven into pads of the proper size and thickness.

Re-Nu is the name by which the semi-permanent filter is designated. The renewable pad is contained in a metal casing having expanded covers. Removal of two screws permits the lifting of the cover from the casing and the substitution of a new filter pad for the old one. In the Throway type, the pad is contained in a cardboard casing making it practical to discard the entire filter when it has accumulated a sufficient quantity of dust to restrict the air flow.

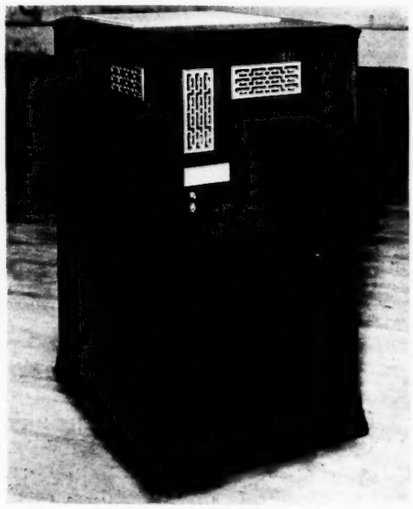
Re-Nu air filter

Two standard sizes, 20 in. x 20 in. and 16 in. x 25 in., are regularly supplied, and other sizes may be purchased in quantity lots.

ChilAire Coolers

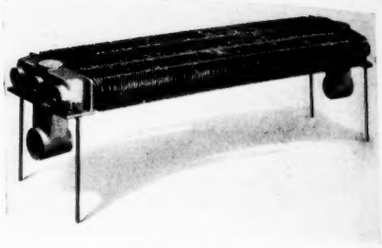
A portable air cooler, using ice as a refrigerant, is manufactured for domestic, store, and office application by ChilAire Corp., Kansas City, Mo.

These coolers employ the dry system, in which water in contact with melting ice is circulated through a radiator-type heat absorber, and warm air, in passing over the cold surface, is chilled below the dew point, precipitating moisture and reducing humidity. The cooled air is then discharged into the room through front and side grilles by a blower. The ice tank, located in the lower rear of the cabinet, receives a charge of 250 lb. of block ice, or 300 lb. of broken ice.



ChilAire ice cooler

Centrifugal pump, blower, and 1/8 hp. motor, assembled on one shaft and comprising a single unit, can be withdrawn from the cabinet for inspection and repairs. Cabinets are available in mahogany, walnut, or white finish, and are 49¼ in. high, 27½ in. wide, and 31½ in. deep. A single charge of ice is sufficient for about 8 hr. to 11 hr. cooling, depending upon the temperature desired, and the volume cooled.



Convectofin heating element

Convectofin Built-in Heaters

A line of built-in heaters, named the Convectofin, for steam systems, has been announced by Commodore Heaters Corp., 11 West 42 St., New York, N. Y.

Heating elements consist of copper tubes, fitted with copper fins. A coating of high temperature alloy is applied to the entire assembly, for durability and promotion of heat transfer. Headers are of one-piece cast iron construction, and the tubes are expanded through tapped holes directly into the castings. It is claimed that careful sizing and fitting of tubes and tappings at the header points make bushings unnecessary. Round iron legs fasten the tubes to the headers to make a rigid unit.

Circulation is by convection, warm air entering at the bottom and discharging through the upper grille after being warmed by contact with the tubes and fins. There are a number of combinations obtainable, including flush type, wall type, floor type, concealed type and offset type.

Premo Automatic Gas Units

Frantz-Carroll Systems, Hanna Building, Cleveland, has announced the Premo automatic gas conversion unit.

A valve reduces the gas pressure below that in the main, after which the gas passes to a shut-off valve which operates through the pressure of the blower, and also by the safety pilot. A gas orifice dial, having graduated openings suitable for each type of gas ranging from the lowest heating value to the highest, and which is set for the gas in the territory to which the unit is shipped, regulates the flow of gas.

There is also a mixture orifice dial with graduated openings to be set for the correct amount of air and gas mixture to be delivered to the burner.

Frantz-Carroll conversion burner

Advantages claimed include the provision for scientific setting to conform to the exact B.t.u. value of the gas, simplicity and low cost of installation, and quietness of operation.

Aero Indicating and Recording Hygrometers

Aero Instrument Co., 3559 W. 122 St., Cleveland, is manufacturing a recording hygrometer and an indicating hygrometer for industrial and domestic use.

Both instruments register by means of the expansion and contraction of treated human hair, which reacts in accordance with the relative humidity conditions prevailing in the air with which it is in contact. The recording hygrometer is contained in a lacquered, rust-resisting metal case. It records the relative humidity on a paper diagram mounted on a 7-day revolving drum. The indicating hygrometer has a thermometer attached, and the relative humidity is read on a dial.

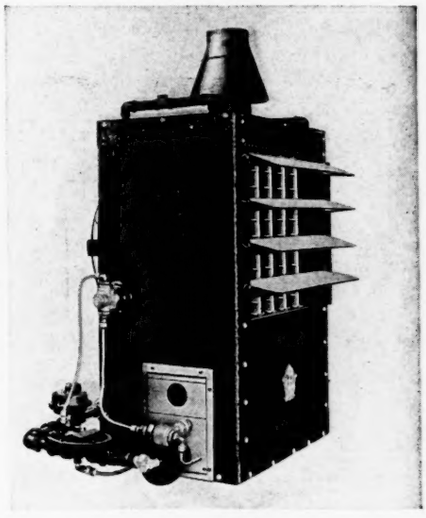
Magicaire Gas-Fired Unit Heater

F. O. Schoedinger, 322 Mt. Vernon Ave., Columbus, Ohio, has announced the Magicaire gas-fired heating and cooling unit.

Operation is entirely automatic. A fan mounted to the rear of the device is started and stopped by a room thermostat as the room temperature varies. A stand-by thermostat, mounted on the inside of the casing, turns the gas supply on and off to maintain a certain set temperature in the heater, entirely independent of the operation of the room thermostat. This prevents the circulation of a blast of cold air throughout the room when the fan is automatically switched on as the temperature falls below the setting.

When the room is up to temperature, the room thermostat breaks contact to the fan motor, and stops it. The gas burner will continue in operation, however, until it has built up the temperature within the heater case to a point above the setting of the stand-by thermostat.

Cast iron construction is used throughout in the heating surface, which comprises a one-piece combustion chamber, the main radiator section, and the header, the last providing the flue connection. Removable baffles are placed in the vertical passages of the main radiator section to retard the upward flow of the heated gases so that the heat may be extracted from them by the action of the air from the fan. These vertical sections are diamond-shaped and are said to give a large area of heating surface with a minimum of resistance.



Magicaire unit heater

Standard equipment includes a 12 in. propeller-type fan having six blades, driven at 1225 r.p.m., delivering approximately 750 c.f.m. The casing is of heavy gauge steel, reinforced and tied in with the heating sections, and is finished in black crinkle finish with nickel trim. Nickel-plated louvers are provided at the front of the heater.

Midwest Shaped Welding Nipples

A line of shaped welding nipples which eliminate all templates when saddling one pipe upon another, has been placed on the market by the Midwest Piping and Supply Co., Inc., St. Louis, Mo. The nipple is placed in position before the opening is cut in the pipe, and the correct opening is traced from the contact line. Both the shaped end and the square end are beveled for welding.

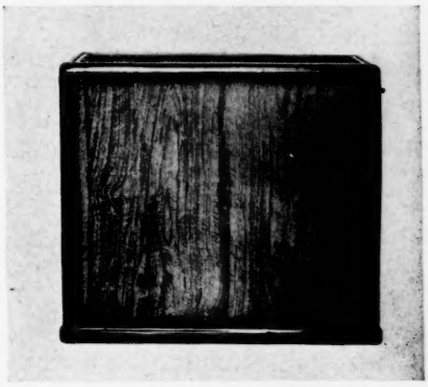
Both 90° and 45° nipples are regularly made from standard weight and extra heavy wrought steel pipe and genuine wrought iron pipe in sizes from 1¼ in. to 12 in., inclusive. On special order they can be supplied with any type of forged lap or flange. Other angles and sizes are available upon application.

Addition to Sirocco Line

American Blower Corp., Detroit, Mich., has announced the addition of a restaurant, store, and office heating and cooling unit to its line of Sirocco conditioners.

Air is taken in and discharged through the same grille to assure the exterior casing being maintained at room temperature so as to prevent condensation on the surface. The heat transfer coils are designed for water circulation at any temperature between 35° and 200°, but are not suitable for steam or direct expanded refrigerants. The volume of water passing through the unit can be regulated by a noiseless control valve, accessible through a covered hand-hole in the end panel.

Standard electrical equipment is for 110 volt, 60 cycle, alternating current. Direct current, or 25 and 50 cycle alternating current motors are optional.



American Blower air conditioning unit

New Equipment

Century Repulsion Start Single Phase Induction Motors

A new line of brush riding single phase repulsion start induction motors has been developed by the Century Electric Co., St. Louis, Mo. These motors are intended primarily for those applications where the most quiet operation or the higher operating characteristics are not required. This line of motors is not intended to replace the Century brush lifting motors, which will be continued for long hour per year applications, such as refrigerators, oil burners, and stokers.

Buffalo Forge Shortboy Ventilating Units

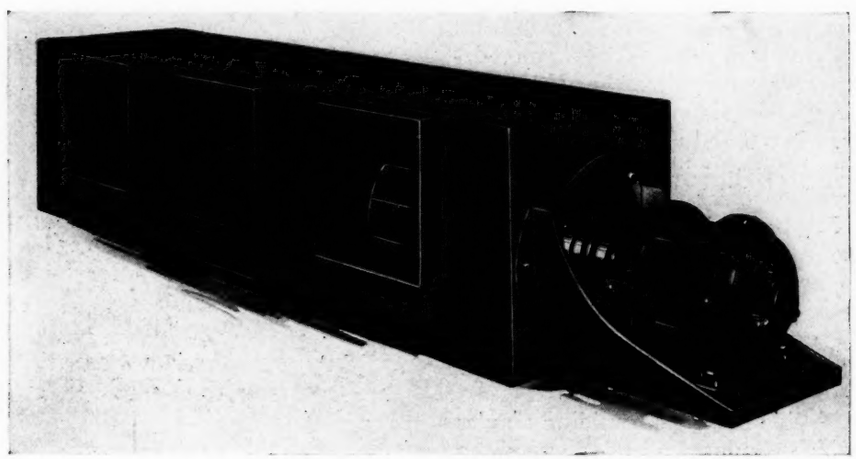
Buffalo Forge Co., Buffalo, N. Y., is marketing the Shortboy ventilating unit, particularly recommended for use in applications where headroom is limited.

Units can be furnished with one to four fans, all arranged on the same shaft and direct-connected through a flexible coupling to a single-driving motor. They can be arranged for either top, side, or bottom discharge, opposite or at 90° to the intake.

Two types of multiblade fans are available. Type N is for low speed operation, while Type D, having a backward curved blade, is for medium speed operation. Type D fans have a rising pressure characteristic and are best suited for industrial applications. Each rotor is of the double inlet design, with bearings and motor outside the air flow so that they cannot be injured by air carrying dirt or corrosive gases.

Ball bearings are standard equipment throughout.

Seven sizes are made, ranging in capacity from 340 c.f.m. to 10,200 c.f.m. at a static pressure of ¾ in.

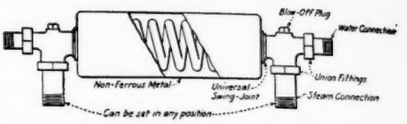


Shortboy ventilating unit

Erskine Rustless Hot Water Heaters

An indirect water heater constructed entirely of copper is being manufactured by Erskine Copper Radiator Corp., 1 East 42 St., New York.

Connections to the heater are made of bronze fittings, joined to it by universal joints, which simplify the work of attaching the unit to the system. The water inlet, steam inlet, and blow-off plug are contained in one fitting, reversible on either end. These fittings will also accommodate an aquastat for regulating the water temperature. The nonferrous construction prevents destruction of the unit by corrosion, and eliminates the circulation of rusty water in the system.

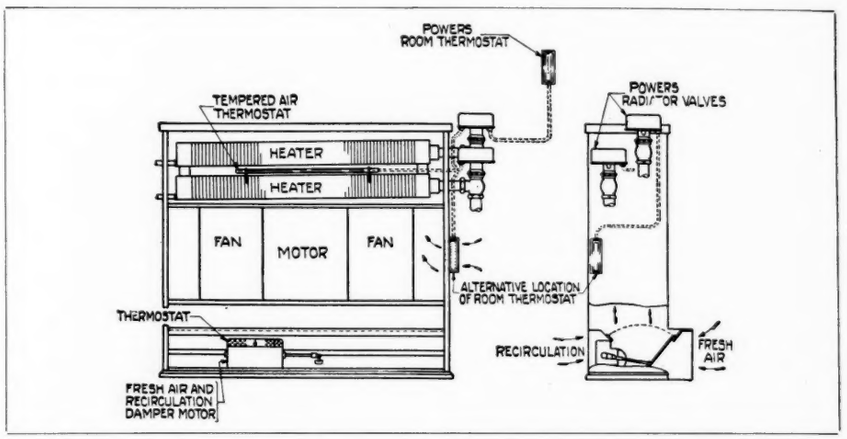


Erskine indirect water heater

Heaters are made in seven sizes, ranging in capacities suitable for small dwellings to large institutions and industrial plants.

Double Heating Unit Temperature Control

A method of effecting automatic control of double section heating units has been patented by The Powers Regulator Co., 2720 Greenview Ave., Chicago. The idea is designed to overcome the cold drafts and overheating which may result from controlling the lower or tempering radiator by a thermostat exposed to the incoming cold air.



Method of application of Powers double heating unit temperature control

With this method, the radiators are separated and space is provided so that the thermostat controlling the tempering radiator is located in the path of the air as it leaves the preheating section. It is usually set for operation at 65°, so that air cannot be delivered to the room at a temperature so low as to cause objectionable drafts, or so high as to cause overheating.

A second thermostat, located either in the room or in the casing where it will be influenced by recirculated air, controls the upper or heating section of the radiator.

News of the Month

House Passes Home Loan Bill as Republicans Advocate It in Platform

Favorable action on the Luce Bill (H. R. 7620), was taken in the House of Representatives June 15, when the measure to provide for the establishment and supervision of a system of Federal home loan banks was passed and sent to the Senate. Two amendments were incorporated into the measure before its enactment. One limits membership in the system to building and loan associations, savings and loan associations, cooperative banks, homestead associations, and savings banks, and the other restricts the rate of interest and other charges to the borrower so that the maximum cost to him shall not exceed the legal rate of interest.

Important provisions contained in the bill include establishment of from eight to twelve Federal home loan banks in districts to be determined by a Federal home loan board to be set up by the President, comprised of five members appointed by him with the confirmation of the Senate. Each bank would have a minimum capitalization of $5 million. The amount of the capital not subscribed by members would be subscribed by the Treasury Department 30 days after the institution is open for subscription.

Advocates of the bill list the following as the purposes it will serve: refinancing of existing mortgages to permit smaller payments and accommodate the needs of withdrawing members and depositors; supplying the institutions with funds, to enable them to carry borrowers meeting payments with difficulty; assisting borrowers to meet taxes and insurance costs; providing funds for modernization, repairs and maintenance of existing homes; providing a source of funds to refinance short-time mortgages, which are embarrassing many homeowners at present, and to stimulate the building of small homes.

A declaration of support for this measure is included in the platform of the Republican party as presented to the Chicago national convention.

Building Trades in New York Agree to 15% Cut

Acceptance of a wage cut of approximately 15% for journeymen, and 17% for helpers by metropolitan New York building trades unions at a conference, held at the Building Trades Employers' Association headquarters June 15, effectively ended the strike which began May 2, and placed 25,000 men at liberty to return to work. The new wages have been placed at $11.20 per day for mechanics and $8.25 per day for helpers, instead of the $10 and $7 rates, proposed previously by the employers' association.

In announcing the agreement, C. G. Norman, chairman of the board of governors of the employers' association, stated that the agreement had been reached on the part of the employers to relieve owners who have projects on hand in order that the association might do its share to provide employment at the present time. He feels that the agreement will have a tendency to improve the building industry in the city. About 130,000 men are involved in the agreement.

District Heating Engineers at Annual Convention Express Confidence in Their Industry

That the district heating industry is ably weathering the present depression was the opinion expressed at the twenty-third annual convention of the National District Heating Association, held at the William Penn Hotel, Pittsburgh, Pa., June 14-17. Although the attendance was somewhat smaller than in previous years, this did not affect the quality of the reports and papers presented.

The convention was welcomed to Pittsburgh by F. R. Phillips, president, the Philadelphia Company, who outlined the growth of Pittsburgh and traced the simultaneous growth of district heating in that city. His welcome was acknowledged by D. L. Gaskill, secretary of the association.

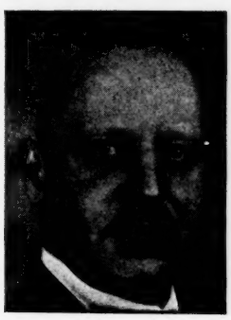
In his presidential address W. W. Stevenson, Allegheny County Steam Heating Company, reviewed the work of the association during the year.

The report on constitutional amendments was presented by Mr. Gaskill.

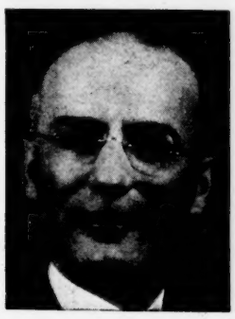
In the absence of L. S. Smith, Rochester Gas & Electric Corporation, Rochester, N. Y., the report on the World's Fair Exhibit at Chicago, 1933, was presented by Secretary Gaskill. The plan now being con-

V. A. Berghoefer, finance

Ernest Szekely, publicity



E. A. Jones, golf



F. G. Weimer, banquet

C. H. Randolph, ladies' entertainment

Five of the committee chairmen who helped to arrange the A.S.H.V.E. summer meeting

sidered is that manufacturer members desiring to exhibit their products at the exposition will use exhibition space.

J. H. Walker, Detroit Edison Company, presented the report of the educational committee, stating that the association's handbook was off the press and in process of distribution. Mr. Walker's report was followed by a report on the handbook by C. H. B. Hotchkiss, editor of the handbook.

A nominating committee consisting of F. B. Orr, J. H. Walker and D. S. Boyden, was appointed.

In the financial report of the association, Mr. Gaskill reported that there were 10 less members than last year, and that the financial condition of the association was sound, with a cash balance on hand.

George E. Whitwell, vice-president, Philadelphia Electric Co., Philadelphia, presented the address which opened the second session. His subject was "Sales and Selling Methods," the talk consisting largely of rules and observations drawn from the speaker's experience.

J. E. Seiter, chairman, sales development committee, described the developments which have taken place in Baltimore during the past year. He felt that the progress has been gratifying. S. S. Sanford, in reporting for Detroit, stated that the sales program is difficult under present conditions but that the load is being retained while cooling is receiving some attention. Henry L. Martin reported that of the two large new building projects in Boston, the printing plant of the Church of Christ, Scientist, and the post office, the printing plant will be served by district steam, while the prospects are bright for its use in the post office. R. L. Fitzgerald, Indianapolis, described the progress made in that city.

Following this, C. E. Redfield, American Radiator Company, outlined in a most interesting fashion the general principles of selling, illustrated by examples.

E. A. Lueky, chairman, presented the report of the meters and accessories committee.

The committee urged a closer relationship between manufacturers of metering equipment and the committee, and referred to the cooperation between similar groups in the National Electric Light Association.

The committee hopes to follow the practice of the American Water Works Association, American Gas Association and the N.E.L.A., in standardizing metering equipment used in the steam industry. In that connection, the committee proposed specifications for the steam condensate meters, a definition of terms being included.

H. J. Bauer, New York Steam Corporation, chairman of the committee, presented the report on station operation by outlining the scope of the committee's work, and closed by suggesting that the future work of the committee should emphasize means of reducing production costs. The breadth of the committee's work is indicated by the diversified list of papers in the report. This included: Effect of Accident Prevention on Steam Production Costs; Selection and Utilization of Fuels; Training and Development of Plant Personnel; Continuous Blow Down Systems, and Estimating Peak Demands on a Steam Heating System.

The report of the hot water committee was not read, but will appear in the proceedings of the association.

The nominating committee proposed the following as officers for the coming year: president, E. E. Dubry, Detroit; first vice-president, J. E. Hillemeyer, St. Louis; second vice-president, Wm. J. Baldwin, Jr., New York; third vice-president, R. L. Fitzgerald, Indianapolis.

The evening session, Wednesday, witnessed an innovation in the convention procedure. The entire evening was given over to manufacturers of apparatus so as to en-

For the first time in history a national political convention was held in an air conditioned building when the Republican National Convention, shown above, met in the Chicago Stadium June 13-16. Perversely enough, the weather, which during past conventions has been scorching hot, was fairly comfortable while the 1932 delegates were in the Windy City.

able them to describe developments in equipment having application in district heating. Heretofore, these talks have been scattered through the program and as a result were usually cut short on account of time. This year, however, a considerable number of manufacturers availed themselves of the opportunity to present verbally and with lantern slides the progress they have made.

The report of the commercial relations committee was presented by S. S. Sanford. The report included a study of the value of the degree day unit in estimating steam consumption for the heating of buildings by district steam. It was found that the unit works out very closely for stores and office buildings, while showing some variation in buildings heated for comparatively long daily periods.

Other subjects included in the report were hot water requirements for buildings, stack effect in tall buildings, descriptions of methods used in computing building volumes, and detailed descriptions of experiences with some recent temperature controls.

J. M. Hopwood, president, Hagan Corporation, addressed the convention on effective present day sales activities of utilities and manufacturers.

Following the report of the rates and regulation committee, the report of the research committee was presented by E. E. Dubry, Detroit, chairman of the committee. Subjects covered included the economical thickness of pipe insulation and the report of the sub-committee on corrosion. The sub-committee reported that a corrosion tester is being developed. The test method consists of inserting test specimens made from steel wire into the corroding material. The loss of weight is a measure of the corrosion. Use of this tester is now being studied and the committee made recommendations concerning its use.

V. S. Day, chief engineer, Carrier-Lyle Corporation, spoke on the subject of air conditioning.

At the Friday session, the officers, as nominated, were duly elected. A. D. Leach, Portland, Ore., presented the report of the operating statistics committee, of which he was chairman.

John F. Collins, Jr., Pittsburgh, brought in the report of the distribution committee. This report included a study of distribution line losses, comparison of standard conduits, comparison of district heating systems, and a report on district heating in Europe.

News of the Month

Safeguarding of Government Aid to Housing Urged

A communication sent to President Hoover, both houses of Congress, and the Reconstruction Finance Corporation by the Housing Section of the Welfare Council of the City of New York, urges that Federal aid to large-scale, low-cost housing projects be safeguarded by administration through state housing boards, by establishment of minimum standards of construction, and by subordination of land costs to building costs.

Such provision would insure against abuse of Federal funds in carrying out these housing projects. It is suggested that in apportioning Federal aid, preference be given to projects where the property owners are willing to accept, as security for 50% or more of the fair value of their property, the common stock of limited-dividend housing corporations or other securities subordinate to the bonds or mortgages to be purchased by the use of Federal funds. It should also be stipulated that for the 50% of the land value having security equal to or greater than that given to the Federal funds, mortgages should be accepted by the property owners involving no immediate or early payments in cash.

To promote social welfare and provide for proper economies in construction, and in heating, service, and administration expenses, all developments should be undertaken on areas large enough to provide real and permanent assets to the community. To prevent Federal aid to sub-standard housing in states not having adequate housing legislation, it is further suggested that the Reconstruction Finance Corporation, before allocating any funds, secure the advice and assistance of the Division of Building and Housing of the Bureau of Standards as to certain minimum requirements to be made applicable to Federal aid housing in all states.

Illinois Central Air Conditions Fast Trains

In accordance with the policies of a number of other important railroads throughout the country, the Illinois Central has air conditioned a number of passenger cars. The first installations are being used on the company's fast noon trains operating between Chicago and St. Louis. The equipment was put into service June 25.

Pre-cooling of the cars is accomplished by blowing the refrigerated air into the cars by means of portable equipment. The temperature in the cars can be reduced at least 10° below the outside temperature in this manner. The Pennsylvania Railroad is using a similar plan for cooling cars.

New York Central Uses Pre-Cooling Equipment in Terminals

Passenger cars on the principal trains of the New York Central Railroad are being pre-cooled before leaving the terminals during the summer. In addition, mechanical cooling equipment is in operation in the dining cars of the important trains.

Refrigerating Engineers Hear Four Papers on Air Conditioning

Papers on the ejector method of refrigeration were outstanding among those presented at the nineteenth spring meeting of the American Society of Refrigerating Engineers, held at Massachusetts Institute of Technology, Cambridge, Mass., June 9-11.

At the first session, June 9, D. K. Dean, Foster-Wheeler Co., New York, presented a paper on "The Steam Ejector for Industrial Refrigerating Capacities." Mr. Dean explained the principles of and

methods of calculating capacities for this system of refrigeration. The speaker stated that a steam ejector system could be operated on steam at 15 lb. gauge, and that temperatures as low as 20° to 30° can be attained. In reply to a question as to the steam consumption, Mr. Dean replied that this depended on the condition of the condenser water and other variables, but that in general the system would use 26 lb. per hr. per ton with saturated steam at 150 lb. gauge.

"The Mercury Ejector Refrigerator" was the title of a paper by L. F. Whitney, Comstock & Westcott, Boston, Mass. This method of cooling is the same in principle as the steam ejector method except that mercury is used instead of steam, water in both cases being the refrigerant. The method was developed principally for refrigerators, but it is claimed that it can be used for small air conditioning units up to two tons capacity. Theoretically, with this method, 77% of the heat input is obtained as refrigerating effect but actually 32% is recovered. On the larger units, such as would be used for air conditioning, 42% is recovered.

R. W. Waterfill, Carrier Engineering Corporation, discussed "The Steam Ejector for Air Conditioning Passenger Cars," in which the speaker described the method developed by his company. One advantage of this method of cooling railway cars is that the energy is converted directly from steam into refrigerating effect, whereas with other methods the steam must first be converted into mechanical energy.

On the afternoon of June 9 the visitors inspected the laboratories of Massachusetts Institute of Technology, following which several refrigerating plants in Boston were inspected.

The second session, June 10, was held on board the S. S. *Dorothy Bradford* en route to Provincetown. The first paper was that by W. J. King, General Electric Company, on "A Review of Heat Transmission Developments." While the author did not claim that his paper was original, he has collected a considerable amount of data which heretofore have been scattered, some of them being available only in other languages. A particularly interesting point brought out by the speaker, and one little appreciated by heating engineers, is that while dry air is transparent to radiant heat, air is never completely dry, and that with a blanket of air 10 ft. thick, with a relative humidity of 20%, approximately 23% of the radiant heat would be absorbed by the air.

"The Mechanism of Moisture Absorption in Insulation" was the subject presented by A. A. Berestneff, Cambridge, Mass., in which the speaker presented an analysis of the available data on the subject. He pointed out that the heat transmission coefficient of various types of construction can be considerably changed by their moisture content.

O. W. Armspach, Carrier Engineering Corporation, presented some surprising data in his paper on "Climate in the United States," in which he showed that in an air conditioning system, designed for a given dry bulb temperature, as the outdoor temperature drops, more cold air is actually required than when the dry bulb is at a maximum. The speaker showed how Weather Bureau data on wet and dry bulb temperatures can be converted into corrected figures for which the system should be designed. The relationship is not a constant.

How Bustem Bust 'em

By Ab El Pilauf

THE muezzin, upon the minaret, had ceased his call to Allah. A group of the followers of Mahomet sat idly upon their prayer rugs and gave voice to the usual wails about their business. Said Abou-Jib:

"What profits it us to compete against each other? Can we not do our work at a profit that will provide sustenance for ourselvs and our half-starved camels?"

His companions nodded, dismally.

"If we could do less work, with more profit—" began Hassan, but Wazir interrupted.

"I have given this matter much thought. Now, here is the answer to my prayers to the Prophet." The others listened attentively.

"Each of us employeth a high-priced estimator, who guesseth how many wilt be, and how much wilt cost the braziers we furnish the tents of our customers. Now, let us abolish these parasites and have one of the least sinful of them tell us what price shalt be the braziers for each job. Then, forsooth, all our prices wilt be alike and our customer shalt pick which of us shalt inflict his work upon him.

"But, remember," added Wazir, warningly, "Thy price shalt not be slit, cut, chiseled or monkeyed with."

"Selam aleikum!" cried his listeners, admiringly. And forthwith, each of them departed to his own bazaar and fired his estimator.

Before two moons had kissed the desert sands, the bazaars of all save that of Bustem became like unto a Mosque. For the shrieks of silence that emitted from their places of business told all and sundry that the brazier business was once more on the bum.

And Bustem, with platoons of salesmen storming

Wage Survey Reveals Wide Range of Rates

Steamfitters' wages range from 50 cents per hr. to $1.75 per hr., ac-

cording to a labor wage survey report compiled for 245 cities in the United States by the Heating and Piping Contractors National Association. The low rate of 50 cents per hr. is prevalent at Hanover, Pa. The minimum wage paid to steamfitters' helpers is revealed as 20 cents per hr., which is paid at Augusta, Ga., and High Point, N. C. In some localities, steamfitters' helpers are receiving as high as $1.23¾ per hr. At Augusta, Ga., and at Macon, Ga., laborers in this industry are paid at the rate of 15 cents per hr., while for Meridian, Miss., the rate is given as from 10 cents to 25 cents per hr. Several communities report laborers' wage rates as high as $1.12½ per hr.

With few exceptions, the supply of men available for heating and piping work is recorded as "plentiful", several localities reporting as low as 5% employed. For a few sections the supply of men is reported as "equal", while one community, Watertown, N. Y., describes the supply as "scarce."

his portals, seemed never to be present. He almost wore the humps off two of his camels, so far and hard were his journeyings. And his colleagues were given to marvel much and were much wroth, for there seemed no need for Bustem to chase business, now that they had this new set-up. And they wondered that he should be so popular with those who would fain buy braziers. So they summoned him to the wailing place of their association.

"How, now, Bustem?" said Exzec-Sec. "Thy brothers hath made complaint about thee that thou grabbeth all the work from Oran to Mecca. Tell us now, what magic thou useth, that thy brothers may profit also."

"My magic is that of personality and service," said Bustem, haughtily.

Then Abdullah rose and spat. "This viper lies," he orated, noisily. "I have trailed him for half this present moon, and he scooteth from oasis to oasis, buying choice dates which he giveth to those he doeth business with. This guy is not a contractor, rather hath he gone into the grocery business. And as we provide him with his estimates, and as we hath not competed with him, he hath grabbed all the work."

Then the meeting busted up in an outcry, and Exzec-Sec lost his job, and they all went out and bid bigger and better jobs for nothing.

Whitlock Tells Baltimore Engineers About Smoke

In a talk given May 12 before the Baltimore section, American Society of Mechanical Engineers, Col. Elliott H. Whitlock, research professor in charge of smoke abatement investigations, Stevens Institute of Technology, Hoboken, N. J., outlined theories and methods of smokeless firing. A description of the results achieved through smoke control in Hudson County, N. J., was included.

Norman A. Hill, smoke commissioner of Baltimore; Prof. A. G. Christie of Johns Hopkins University; and A. L. Penniman, superintendent of steam stations of the Consolidated Electric Light & Power Company, contributed to the discussion which followed.

Fitts to be Officer of New York Trade Executives

Joseph C. Fitts, secretary of the Heating and Piping Contractors National Association, was elected vice-president of the Trade Association Executives in New York at a meeting held May 24 in the Commodore Hotel. The president of the group for the ensuing year will be J. S. Marvin of the National Automobile Chamber of Commerce.

Mr. Fitts has taken an active part in the work of the Trade Association Executives during the past few years. As vice-president, he will have complete charge of all programs for the group during the coming year. The organization includes 150 executive managers of trade associations having headquarters in New York.

Ice Industries Present Sales Program for Comfort Cooling

A comprehensive sales and development program, comprised of seven separately bound sections, each devoted to some phase of comfort cooling with ice as the refrigerant, has been prepared for the use of its members by the National Association of Ice Industries. The program is planned so that it will be of equal value to the organization which operates one or 100 plants.

Section 1 contains a brief history of the development of air conditioning and comfort cooling, outlining methods by which they are accomplished. A survey of the market for comfort cooling and for ice in this field is also included.

"Organizing to sell Comfort Cooling" is the title of Section 2, in which the selling plan is described in detail. This section is designed to be sufficiently comprehensive to enable the sales manager to plan a program that will enable his company to enter this field on a sound

News of the Month

basis, and to avoid losses and wastes that are usually met in pioneering activities in a new industry. This section is intended for the individual who will organize and direct the comfort cooling sales campaign.

Section 3 is a sales manual designed to provide the salesman with the fundamental data and information he will require in his work. In addition to defining terms and outlining basic operations, this section presents a model interview.

Photographs of iced comfort cooling installations, in combination with advertising material directed to the prospective user, are presented in Section 4. Data are given on ice consumption and performance, and a sample temperature chart is included. This section is bound loose-leaf so that material may be added.

A model proposal is illustrated in Section 5, in which a method of presenting the proposal is illustrated and suggestions made for methods of incorporating the contract for ice supply, and the handling of other matters in connection with closing the contract.

Section 6 is designed to be an introduction to the file which will be assembled by the sales manager to contain the names, policies, and descriptions of products of the various manufacturers in this field.

Esten Bolling

Esten Bolling, engineer, editor, and advertising agent, was found dead from a self-inflicted gun shot wound in his home in Mountain Lakes, N. J., June 18.

Mr. Bolling, who was 38 years old, was a member of the Bolling family of Virginia and a cousin of President Woodrow Wilson's second wife. He was well known as a writer of articles on heating and ventilating, and at one time was editor of the popular house organ of a leading air conditioning manufacturer.

W. C. Redfield

William C. Redfield, Secretary of Commerce in President Wilson's cabinet, died in his sleep June 13. For more than 30 years he was engaged in manufacturing, and was president of the Sirocco Engineering Company, 1907-11, and vice-president of American Blower Company, 1909-13.

Henry G. Keasbey

Henry Griffith Keasbey, a pioneer in the asbestos industry and a retired manufacturer of pharmaceutical preparations, died of heart disease in Philadelphia, May 30, after a prolonged illness. He was 82 years of age.

After his graduation from the Philadelphia College of Pharmacy, Mr. Keasbey and Dr. Richard V. Mattison founded the pharmaceutical manufacturing firm of Keasbey & Mattison. Some years later the company branched out and established an asbestos textile plant.

COMING EVENTS

OCTOBER 10-14, 1932. Fourteenth Annual Convention of the American Gas Association, to be held in Atlantic City, N. J.

NOVEMBER 30-DECEMBER 4, 1932. Annual Meeting of the American Society of Mechanical Engineers, to be held in the Engineering Societies Building, New York.

DECEMBER 5-10, 1932. Tenth National Exposition of Power and Mechanical Engineering, to be held at the Grand Central Palace, New York.

Correspondence

Regenerative Cooling

EDITOR, HEATING AND VENTILATING:

With reference to the article "Regenerative Cooling for Hot Dry Climates," by K. P. Brace, in the May, 1932, issue of HEATING AND VENTILATING, I should like to call to your attention certain conclusions on the part of the author which appear to me to be incorrect.

The following symbols will be used:

T_a = Dry bulb temperature, outside air, °F.
T_w = Wet bulb temperature, outside air, °F.
T_d = Dew point temperature, outside air, °F.
T_r = Temperature rise in passing through conditioned space $= T_c - T_b = 5°$
T_b = Dry bulb temperature of air leaving indirect cooling coils
T_c = Dry bulb temperature of air leaving conditioned space $= T_b + 5$
T_f = Dry bulb temperature of air leaving spray
T_s = Temperature of water in sprays $=$ Temperature of water entering cooling coils $= T_f$
T_e = Temperature of water leaving cooling coils
L = Latent heat of vapor at temperature T_f
W = Lb. of water evaporated per lb. of dry air $= W_2 - W_1$
C_p = Specific heat of mixture of air and vapor
T'_w = Wet bulb temperature of air whose dry bulb $= (T_a + T_r)$ and whose dew point $= T_d$

Mr. Brace assumed that adiabatic saturation took place in the evaporator sprays, and that the air entering the evaporator would be cooled to its wet bulb temperature. This is not true, however, as heat is being constantly added to the spray water in the indirect cooler, so that the air and water in the spray will not be reduced to the wet bulb temperature of the air entering the spray, but rather to the wet bulb temperature of air whose dry bulb temperature is that of the outside air plus the temperature rise in the conditioned space and whose dew point is that of the outside air. In other words, theoretically,

$$T_f = T'_w \qquad (1)$$

or actually due to the fractional efficiency of the sprays

$$T_f = T'_w + 4° \qquad (2)$$

Using the same conditions as given by Mr. Brace:

$T_a = 100°$ $T_w = 70°$ $T_d = 54°$ $T_r = 5°$

Mr. Brace further assumes that the evaporator will cool the air and water to within 4° of the theoretical limit, and the indirect cooler will cool the incoming air within 4° of spray water temperature, or $T_s + 4°$.

Expressed symbolically

$$T_c = T_b + 5 \qquad (3)$$
$$T_b = T_s + 4 \qquad (4)$$
$$T_c = T_s + 9 \text{ (by substitution)} \qquad (5)$$

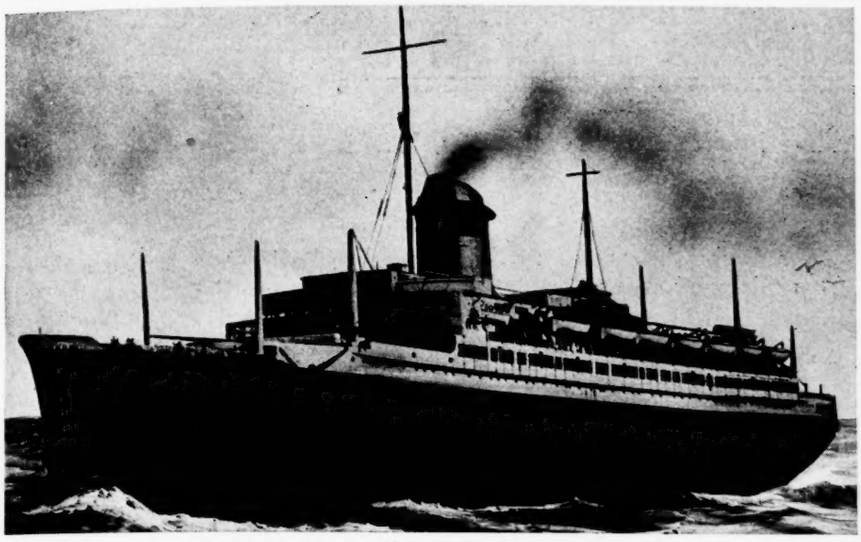
We may now set up a heat equation as follows

$$WL = (T_a - T_b)C_p + (T_c - T_s)C_p \qquad (6)$$

Substituting values for T_b and T_c:

$$WL = (T_a - (T_s + 4))C_p + ((T_s + 9) - T_s)C_p \qquad (7)$$
$$WL = (T_a - T_s - 4 + T_s + 9 - T_s)C_p \qquad (8)$$
$$WL = (T_a + 5 - T_s)C_p \qquad (9)$$

That is, the latent heat of the water evaporated must equal the heat removed from the air in lowering its temperature from T_a or its outside



No Deck Ventilators on New French Liner

The new cabin liner, "Champlain," of the French Line, which docked in New York, June 25, on her maiden trip, carries no deck ventilators. The elimination of the ventilator "trumpets," which usually clutter the sun decks, and elimination of the usual scrubbed-wood decks are departures from the traditional plan of ship design. The architects have designed the ship so that all ventilation will pass through the liner's large single smoke stack which will carry air from below decks high above the uppermost deck to maintain the comfort of passengers. Additional lounging space will be provided and a clear view of the ocean made possible by removal of the ventilators.

condition to T_s or its condition leaving the spray, plus the further removal of the heat added in the conditioned space. Equation (9) cannot easily be solved directly for T_s because of the two unknowns, L and W, which bear no simple relation to each other.

Taking for comparative purposes the operation of a direct adiabatic saturation apparatus instead of Mr. Brace's regenerative system, the latent heat of the water evaporated is equal to the heat removed from the air in having its temperature reduced from the entering dry bulb to the entering wet bulb. Expressed in the form of an equation,

$$WL = (T_a - T_w)C_p \qquad (10)$$

For a regenerative apparatus of 100% efficiency throughout, and with no heat added in the conditioned space, equation (10) would apply and the two systems would be identical from the standpoint of heat transfer from air to water. To take care of the heat added in the conditioned space, let us imagine for a moment a direct adiabatic saturation apparatus located at the exit duct receiving air from the room. Then the dry bulb temperature of the air entering the spray chamber would be T_a plus the rise in the room or $(T_a + T_r)$. The temperature to which the air and water would be lowered (everything 100%) would be the wet bulb temperature of this air which would correspond exactly to T'_w. The total heat absorbed from the air and added in the form of vapor would be $C_p (T_a + T_r - T'_w)$. The mere fact that in the regenerative system part of this heat abstraction takes place in cooling coils placed ahead of the room and delivered by a heat carrier to the sprays does not affect the operation of the system from the thermal standpoint.

This now opens the way to determine T'_w which in turn will give us T_s and all of the unknown temperatures from which we can find L and W and C_p and thus complete the solution and provide a check as follows:

$T'_w = 71.5°$ as determined from psychrometric chart at intersection of 54° dew point and 105° dry bulb.

$T_s = T'_w + 4 = 75.5°$

$T_b = T_s + 4 = 79.5°$

$T_c = T_b + 5 = 84.5°$

The heat equation can now be checked (see (9)) as follows, since latent heat at $T_s = 1048$ B.t.u. per lb. and $W_2 = 0.01577$ lb. vapor per lb. dry air leaving spray, and $W_1 = 0.00887$ lb. vapor per lb. dry air entering spray, and $W = 0.01577 - 0.00887 = 0.00690$ lb.

Substituting in (9)

$$0.0069 \times 1048 = (100 + 5 - 75.5)\,0.245$$
$$7.22 = 7.22$$

C_p as given above is the specific heat of the mixture and is found by adding the specific heat of dry air = 0.2415, to the product of the specific heat of vapor (0.44) and the weight of vapor per pound dry air.

$C_p = 0.2415 + 0.44 \times 0.00887 = 0.245$ B.t.u.

By adding more surface to the cooling coil and spray apparatus, and by increasing the amount of air circulated in order to reduce the temperature rise in passing through the room, the temperature of the air entering the room would approach the wet bulb temperature of the outside air as shown by this solution. It would never, however, aproach the dew point temperature as Mr. Brace states. Mr. Brace's statement of observed experimental data in which the temperature of the air entering the room came within 4° or 5° of the outside wet bulb, checks closely with my solution and was obtained with efficient apparatus and probably a small temperature rise in the room.

When, however, Mr. Brace states that he can obtain a temperature of 70° entering the room, indicating a water temperature in the coils of 66°, I must take exception on the basis that 66° is below the wet bulb temperature of the outside air and, therefore, impossible. As a final check, we must recognize that a perfect regenerative apparatus could not cool the air below the point obtainable with a direct adiabatic saturation application, which in this case would be 70° for 100% efficiency. Mr. Brace has neglected entirely the heating up of the water in the indirect coils which accounts for the erroneous conclusions.

If Mr. Brace's cooler could be operated as he indicates, each succeeding cycle would produce lower air temperatures, and in turn lower water temperatures, until the air entering the spray was at the dew point where no further evaporation was possible. This would be in effect evaporative cooling to the dew point, whereas experience has shown that it cannot be carried below the wet bulb.

O. O. SUNDERLAND

Highgate Springs, Vt.

Business Statistics

(Dotted line in charts, 1931; solid line, 1932)

Bradstreet's reports that the value of new building construction in May was only 12.9% of the average for the years 1920-1930. This is the lowest level reached since the end of 1918. In this connection it is interesting to note that a year after this war-time low, the index stood at 73.6. The building trade is one capable of quick recovery.

There are, however, some encouraging signs. None of the sections of the country is as badly depressed as New York City. In comparison with last year, the Pacific, Mountain and Northwestern regions showed the smallest declines, ranging from about 54% to 60%. The South Atlantic and New England states also made a good showing.

The outlook for the next few months is somewhat improved by the possibility of federal construction programs. The large scale programs under consideration by Congress offer a basis upon which the industry may pin its hopes for some recovery in the fall.

The Bureau of Mines released, during June, its annual publication on coal. This year's edition is titled "Coal in 1930." Voluminous data are included on all phases of coal production and distribution.

The figures below are reprinted from this publication:

Pennsylvania Anthracite Shipments, Domestic Sizes, Tons

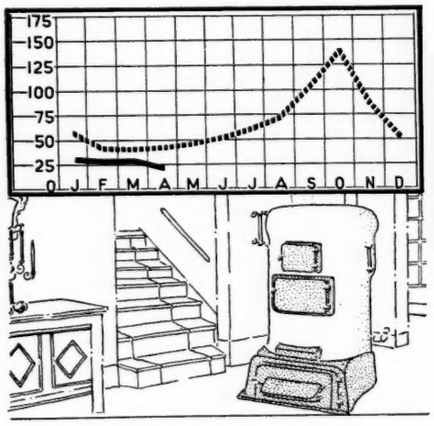
1924	56,576,296
1925	38,305,222
1926	54,096,437
1927	48,999,058
1928	46,218,403
1929	46,141,575
1930	42,508,088

Oil, Bbl. for Building Heating

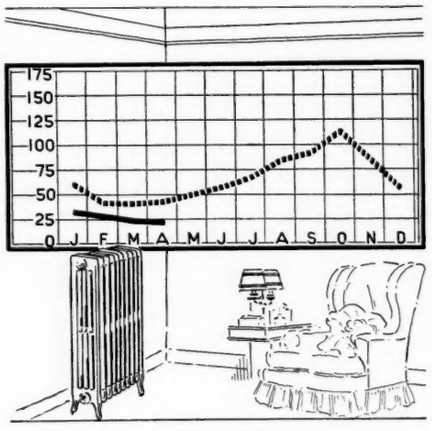
1924	5,021,000†
1925	20,929,000
1926	22,954,000
1927	27,460,000
1928	30,698,000
1929	37,401,000
1930	42,703,000

Natural Gas, Billion Cu. Ft.

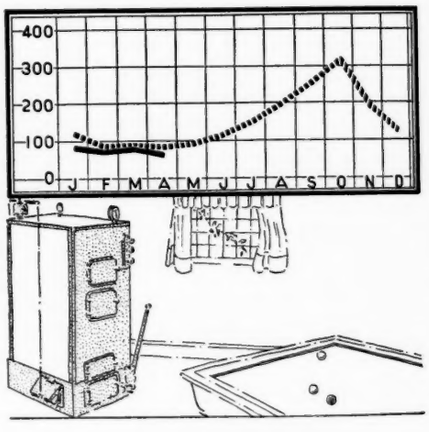
1924	285
1925	272
1926	289
1927	296
1928	321
1929	360
1930	376



Cast Iron Round Boilers
In Thousands of Pounds
April, 1932, 2,309; April, 1931, 4,232; decrease over last year, 46%.



Cast Iron Radiators
In Thousands of Square Feet
April, 1932, 2,367; April, 1931, 4,293; decrease over last year, 45%.



Cast Iron Square Boilers
In Thousands of Pounds
April, 1932, 6,315; April, 1931, 8,448; decrease over last year, 25%.

By-Product Coke

Tons Sold for Domestic Use

1924	2,812,771
1925	4,085,068
1926	5,056,568
1927	4,702,529
1928	6,254,382
1929	7,376,320
1930	7,886,432

†Consumption for domestic heating only.

Allen Beals, Dow Service, estimates that the recent building trades strike in New York cost building supply firms, contractors, mills and railroads not less than $10 million.

The Bureau of Census, Department of Commerce, published recently a collection of quite valuable data on the heating and plumbing industries as part of the Industry Series on Manufactures. The data are for the year 1929. A few of the numerous tables and figures from this publication are presented below:

Manufacture of steam and hot water heating apparatus and steam fittings gave employment to 39,621 wage earners in 1929, as compared with 43,260 in 1927; the number of wage earners engaged in making stoves and ranges and warm-air furnaces numbered 46,616 in 1929, as compared with 46,514 in 1927.

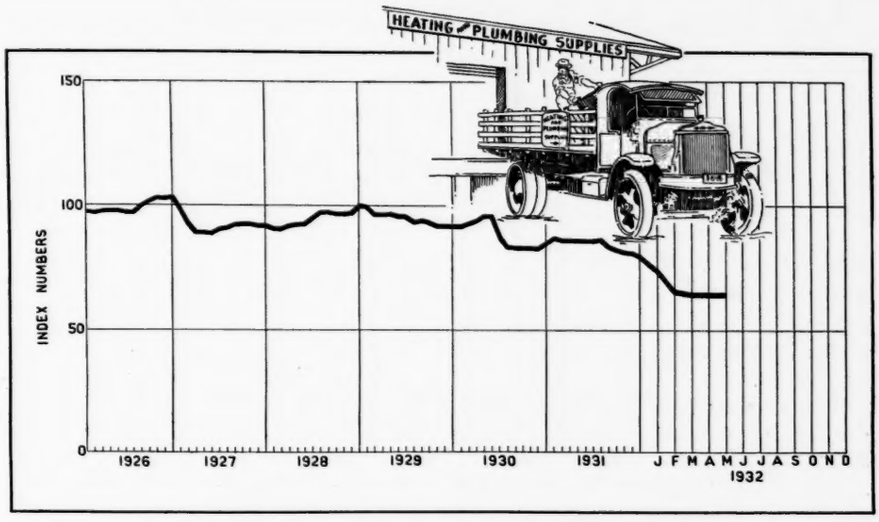
Manufacture of all these classes of equipment required in 1929 the use of $5½ million worth of iron and steel scrap; $13.7 million for iron and steel castings purchased as such; $3 million for iron and steel pipe; $18 million for sheet and plate steel; $15.3 million for copper, brass and bronze, and $17 million for pig iron.

The values of some of the prin-

cipal items of equipment in which we are interested are given in the table which follows. The value is that produced in 1929:

Cast iron boilers	$33,152,631
Steel boilers	5,332,172
Cast iron radiators	37,919,080
Copper radiators	2,757,207
Radiators, other	439,812
Unit heaters	9,238,556
Warm-air furnaces	32,579,551
Registers and furnace parts	10,731,722
Gas room heaters	11,569,718
Gas water heaters	18,203,497
Oil burners for central heat	19,693,666
Domestic stokers	1,115,637
Valves and fittings	90,180,053
Specialties, such as traps, gauges, thermostats	50,550,322

The number of warm-air furnaces manufactured during 1929 was 378,546.



Trend of wholesale prices, heating and plumbing goods

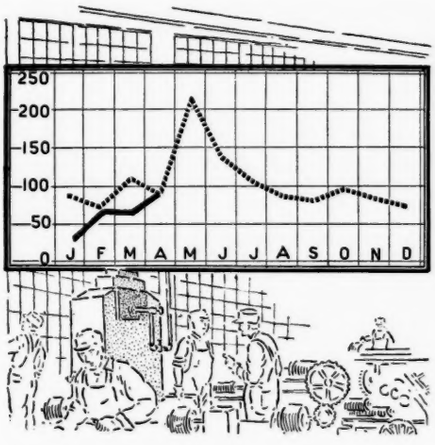
Building permits, as reported by the Department of Labor, show an increase of 24% for May, as compared with April, although ordinarily the May totals are less than those for April. The total new residential permits amounted to $10.2 million, for non-residential, $47 million, and total construction (including alterations and repairs) $67.5 million. The value of new buildings for the U. S. Government permitted during May was more than twice as high as in the preceding month or in May, 1931.

Our chart of wholesale price indexes for heating and plumbing materials, as computed by the U. S. Department of Labor, Bureau of Labor Statistics, shows that prices have, at least temporarily, become stabilized at about 65% of the 1926 average.

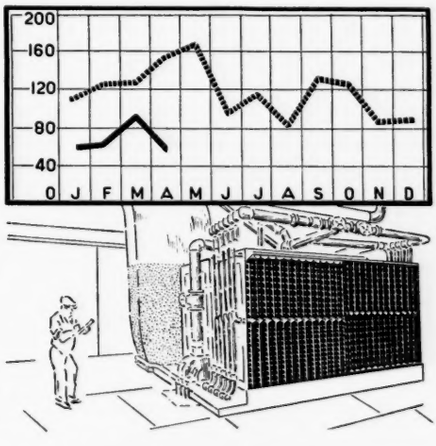
The index for May stands at 64.4, exactly the same as for the two preceding months. Oddly enough, the index for *all commodities*—which includes 784 items, such as foods, textiles, leather, fuel, house-furnishings, etc.—has also dropped to 64.4. The index for the group *building materials* is still 71.5, showing that the other goods which enter into construction of buildings have not dropped in line with heating and plumbing. As a matter of fact, none of the metal products reported by the Bureau has dropped so much in price as heating and plumbing goods, with the single exception of non-ferrous metals. For example, the May index for agricultural implements is 84.9. All indexes may be interpreted as being the percentage of the 1926 average price; that is, the ratio between today's price and the 1926 price.

The summary below shows clearly the trend of prices:

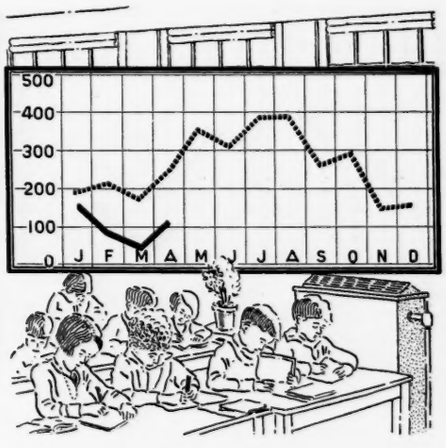
	Heating and Plumbing	All Building Materials	All Commodities
May, 1932	64.4	71.5	64.4
April, 1932	64.4	72.5	65.5
May, 1931	86.6	80.0	73.2



Air Conditioning Units and Washers
Orders in Dollars
April, 1932, 91,977; April, 1931, 90,465; increase over last year, 1.7%.



Indirect Heating Surface
Orders in Dollars
April, 1932, 57,159; April, 1931, 154,341; decrease over last year, 63%.



Unit Ventilators
Orders in Dollars
April, 1932, 108,953; April, 1931, 248,618; decrease over last year, 56%.

Of all the series of production figures collected by the Department of Commerce, of which six are presented here this month, only one shows an increase for April over the corresponding month last year. This group is composed of air washers and air conditioning units, which show a rise for the month of 1.7% over 1931.

With the Manufacturers

St. Louis Utility Exhibits Air Conditioning

A cooperative air conditioning exhibit is being installed by the Union Electric Light & Power Co., St. Louis, to convince the public that air conditioning is meant for the home, just as much as for the office or theater.

The display is expected to dispel the mystery which surrounds air conditioning in the eyes of the average man and woman, and prove that the machinery is not too cumbersome or noisy for home use.

While salesmen will greet all visitors, no attempt will be made to sell callers unless they evince strong interest. A direct mail campaign to the higher-income class will invite attendance.

Among those who will exhibit are: Carrier-York Corporation, Frigidaire Corporation, Ilg Ventilating Company, York Ice Machinery Company, American Blower Company, American Furnace Company, American Air Filter Company, Trane Company, Kool Air-Maker Corporation and Standard Engineering Company.

Westinghouse Denies Manufacture of Oil Burners

Press notices appearing in various publications indicating that the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., is in the business of manufacturing and selling domestic oil burners have been denied by that company, officials stating that the company does not engineer, manufacture or sell a domestic oil burner, nor does it have any financial or controlling interest in any oil burner manufacturer.

The Westinghouse Electric Supply Co., New York, a subsidiary of the Westinghouse Electric & Manufacturing Company, through its jobbing houses distributes motor-driven appliances of various types through retail channels to the public.

As part of its merchandising line, the Westinghouse Electric Supply Company sells oil burners and other appliances not manufactured by the Westinghouse Electric & Manufacturing Company, but its activity in the oil burner field is purely that of a commercial distributor.

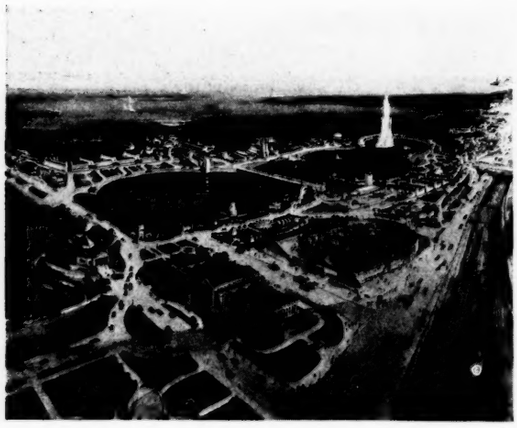
Practical Demonstrations of Air Conditioning Planned for Century of Progress Exposition

Extensive plans for participation in A Century of Progress Exposition, Chicago's 1933 World's Fair, are being made by leading producers in the air conditioning industry, according to an announcement made public by the division of publications of the exposition administration. A large part of the millions of visitors who will attend the exposition next year represent an important potential market for air conditioning apparatus, and enhancement of the already keen public interest in this subject can be effected by skillful exhibits by the various manufacturers.

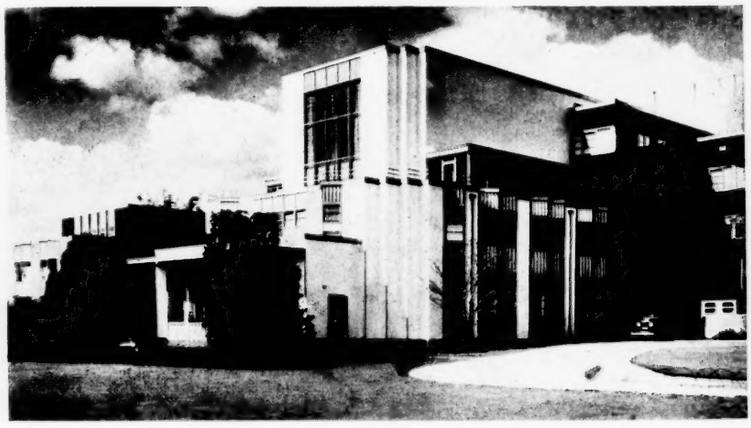
In these displays, the prospective purchaser will experience for himself the effects of conditioned air, and at the same time have answered further questions as to price, maintenance, operation, ease of installation, and other practical considerations.

This equipment will be on display in the Home and Industrial Arts Exhibit, where everything that enters into the construction, equipment, furnishing, and decorating of the home will be shown. It will be the first time that air conditioning has been demonstrated to the public on so large a scale, and it is expected that its appeal will be made not only to homeowners and prospective homeowners, but to architects, builders, and contractors who are influential in promoting a more widespread use of such products.

Eight residences illustrating new uses of building materials and presenting fresh solutions of housing problems, all designed and decorated in a new and modern fashion, and yet conceived with the limitations of the average person's pocketbook in mind, will be built on the fair grounds. In each of these, some phase of air conditioning will be demonstrated. There are also plans in project for a building to be devoted exclusively to air conditioning to be located adjacent to the housing exhibit. Here heating and cooling systems, humidity control systems, unit ventilators, unit heaters, steam and hot water specialties, temperature regulators, air filters, radiation, insulating materials, and other de-



The forthcoming Chicago's 1933 World's Fair, from a painting by Morton R. Addy



The Administration Building for the Century of Progress Exposition

vices contributing to making the home more comfortable and healthful will be shown.

A great many of the buildings and displays for the fair have already been completed, or are now in the process of construction, among them the underground utilities, such as sewers, water mains, and pumping station, with a capacity for providing facilities for peak crowds of as high as 1,000,000 per day. Leading organizations in nearly every field of industrial enterprise are included among the exhibitors.

Air Conditioning Will Require 1750 Tons of Copper Annually

A survey recently completed by the Copper and Brass Research Association, New York, predicts that a total of 3,500,000 lb. of copper will be used by the air conditioning industry during 1932, an increase in consumption in this field of 40% over last year. Should summer cooling and winter humidification of residential quarters reach the degree of public acceptance to which industrialists and conditioning experts believe them to be destined within the next five to ten years, the association looks to an annual market estimated at from 35,000,000 lb. to 45,000,000 lb.

These predictions are justified in the association's report by such considerations as the 100% increase during 1931 of the number of manufacturers producing complete units or parts for air conditioning equipment, the sharp rise in the sale of small cooling and humidifying units, and the discovery that the automobile-type copper radiator provides an inexpensive and effective cooling surface where ice is used as the refrigerant.

Hoover Dam Building to be Air Conditioned

Air conditioning equipment will be installed in the Government administration building at Boulder City, Nev., where direction of the Hoover Dam project is carried on, according to an announcement of Frigidaire Corp., Dayton, Ohio, to whom the contract for the installation has been awarded. Numerous heat prostrations last year prompted the engineers in charge to take action before the coming of the long, hot Nevada summer, during which the temperature rises to as high as 110° and 120°.

Air conditioning units will be the largest Frigidaire products of the type to be installed anywhere thus far, according to that organization.

Breidert Sees Great Future for Air Conditioning

Air conditioning was referred to as a new and growing industry with potentialities possibly greater than those of the automotive industry of 1922, by G. C. Breidert, general sales manager, Ilg Electric Ventilating Co., Chicago, at a recent luncheon-meeting of the Indianapolis Electric League. The speaker further stated that a $5 billion market is indicated for this field.

According to Mr. Breidert, the present demand is sufficiently great and widespread that manufacturers of air conditioning equipment are already faced with the problem of national distribution. Present tendencies indicate that those who will benefit the most from exploitation of the new industry will be the electrical and plumbing and heating manufacturers, supply jobbers, contractors and dealers, with electrical contractors, and public utilities entering into the business with profit as they adjust themselves.

With the Manufacturers

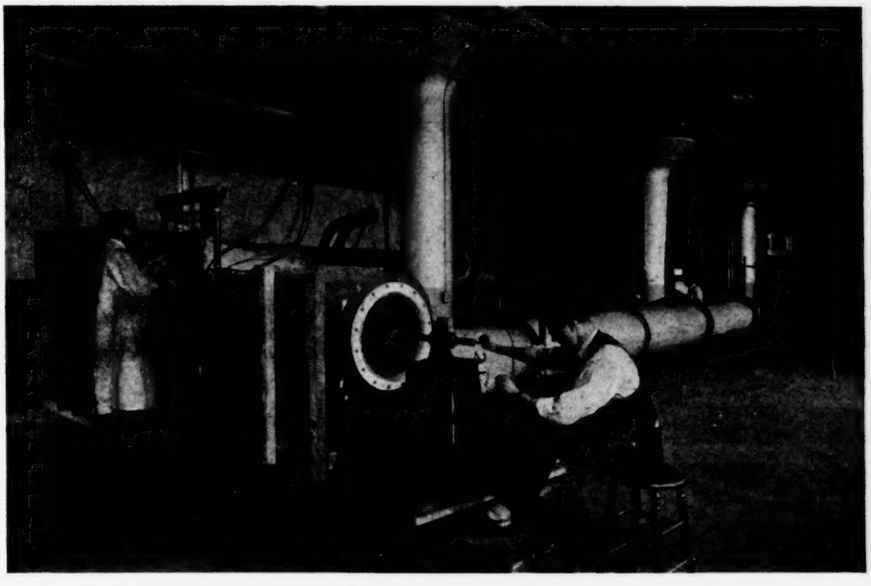
The Penn Electric Switch Co., Des Moines, Iowa, has appointed Edgar G. Hansen, 1041 North 35th St., Milwaukee, Wis., direct sales representative, to serve the state of Wisconsin and the Michigan peninsula.

Reliance Electric & Engineering Co., Cleveland, Ohio, has recently appointed Charles V. Fish to represent the company in Allentown and northeastern Pennsylvania, with offices at 515 North Lafayette St., Allentown, Pa.

Alco Valve Co., Inc., St. Louis, Mo., has appointed Urquhart Service, 2133 Blake St., Denver, Colo., to represent its company in Montana, Idaho, Wyoming, Utah, Colorado and New Mexico. M. B. Urquhart is the head of this company.

Perfex Corp., Milwaukee, Wis., has placed John W. Tambert, formerly secretary and treasurer, in charge of its heating division. The heating line has been enlarged to include concealed radiation. F. A. Tetzlaff has been elected secretary-treasurer to succeed Mr. Tambert.

Holland Institute of Air Conditioning is the new name of the Holland Institute of Thermology, Holland, Mich. The Institute, whose work heretofore has been confined to the science of heating, now launches on a broadened program of research and education which will embrace climatology, meteorology, and air conditioning for the home.



Actual test being run in the research laboratory of the American Blower Corp., Detroit, Mich.

With the Manufacturers

Chicago Pump Co., Chicago, Ill., has announced the appointment of Thom H. Creears, Bendix Building, Los Angeles, Calif., as its representative in that city.

Rome Radiation Co., Division of Revere Copper and Brass, Inc., Rome, N. Y., has appointed the Vance-McCrea Sales Co., West 27th and Sisson Sts., Baltimore, Md., as its sales representative in Maryland, District of Columbia, and Northern Virginia.

Penn Electric Switch Co., Des Moines, Iowa, has announced that Sidney Rente, 775 Main St., Buffalo, N. Y., is now its exclusive sales representative in Western New York and the northern counties of Western Pennsylvania.

Niagara Blower Co., Buffalo, N. Y., announces the appointment of A. E. Edwards, 3622 E. Marginal Way, Seattle, Wash., as its Pacific coast representative. Offices will be established in Seattle and San Francisco.

Ross Heater & Mfg. Co., Inc., Buffalo, N. Y., has appointed G. G. Van Tuyl as its representative for Western New York, with offices in Rochester, N. Y. Mr. Van Tuyl was formerly associated with the sales department of Foster-Wheeler Company.

Arno N. Dietze has been appointed representative of the Company in Milwaukee, Wis., with offices in the Security Building. Mr. Dietze also was formerly connected with Foster-Wheeler Company.

The Gustavo Preston Company has been appointed as the company's Boston, Mass., representative.

The Ohio Electric Mfg. Co., Cleveland, Ohio, has appointed C. Sam Swanson, 1616 Kresge Building, Detroit, Mich., representative in that city for its line of fractional size electric motors.

Allen-Bradley Co., Milwaukee, Wis., announces the appointment of Walter A. Black as district manager of its office at 942 Prospect Ave., Cleveland, and John B. Vogel as district representative in charge of its Grand Rapids, Mich., office, at 41 Grandville Ave., S. W.

American Air Filter Company, Inc., Louisville, Ky., has appointed English & Lauer, Inc., 1224 S. San Pedro St., Los Angeles, Calif., as its Southern California representative.

Penn Electric Switch Co., Des Moines, Iowa, has opened offices at 15 Laight St., New York, for the exclusive handling of export trade, with the exception of Canada. A complete organization will be maintained in this office.

H. S. Woodruff

In charge of design engineering of the newly formed Air Conditioning Department, General Electric Co., Schenectady, N. Y.

The Duriron Co., Inc., Dayton, Ohio, has issued Bulletin No. 166, covering the engineering and mechanical features of Duriron exhaust fans and their installation. Contains dimensional and other engineering data; 12 pages.

Schutte & Koerting Co., Philadelphia, Pa., has issued Bulletin 16-A devoted to mechanical oil burners. Contains 20 pages of technical descriptive matter, engineering data, and illustrations.

American Air Filter Co., Inc., 215 Central Ave., Louisville, Ky., has issued a 26-page booklet, American Air Filters in Industry, containing technical information on industrial dust problems. Among the subjects covered are the use of filtered air for drying operations, control of bacteria and mold spores, cooling electrical equipment, control of process dust, and protection of engines and compressors.

Metropolitan Life Insurance Co., Policyholders Service Bureau, 1 Madison Ave., New York, has issued a 24-page report entitled "The Manufacturing Expense Budget," in which budgetary procedure for expense control in manufacturing establishments is outlined. Part 1 is devoted to a discussion of the problem of expense control, types of budgets, and related subjects. Part 2 presents procedure outlines of the budgeting practices of four representative companies. Copies of the report will be distributed to industrial executives, production engineers, financial officers, and others interested.

Financial News

Thompson-Starrett Co., Inc., and its subsidiary report a net income amounting to $578,423 for the 53 weeks ended April 28, as compared with a profit of $1,785,703 for the fiscal year ended April 23, 1931.

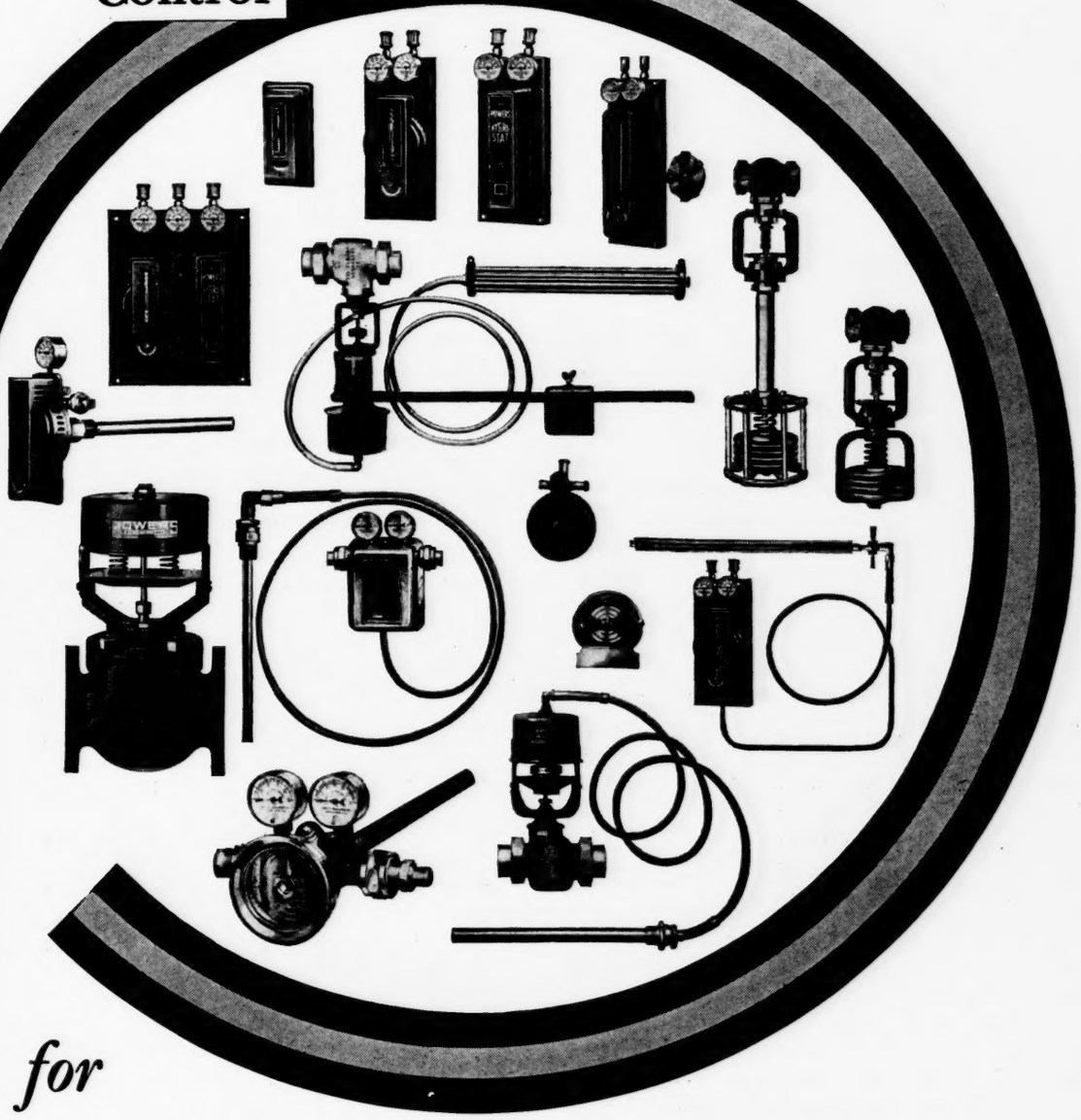
Celotex Company, Chicago. Ancillary receivers in Wilmington, Del., were named on June 17 for the Celotex Company. The company recently reported a net loss for the 12 months ended April 30 amounting to $608,962, compared with a net loss for the 12 months ended October 30 amounting to $130,599. Net sales for the 12 months ended April 30 were $4,653,780, compared with $5,953,405 for the 12 months ended October 30.

Holland Furnace Company reports a net profit of $265,906 for the year ended March 31, compared with a profit of $1,676,403 for the preceding year.

Detroit Edison Company reports for the year ended May 31, a steam revenue of $1,900,072, as compared with $2,424,582 in the preceding year. Electric revenue amounted to $44,688,322, as compared with $48,550,245. Net income was $9,524,838 as compared with $11,103,265.

Associated Gas & Electric System reports for the 12 months ended March 31 earnings of $1,503,759 from its district heating systems, as compared with $1,762,759 for the preceding year, a decrease of 14.7%. The electric business of the system was the only one showing an increase, the gain being 1.0%.

Accurate Dependable Control



for

Air Conditioning Equipment

THE

THERMOSTATS—both graduated and positive acting for dry bulb control. **Hygrostats**—both pneumatic and electric for humidity control. **Self Contained Regulators**—complete line for control of air and liquid temperatures. **Brine Control**—regulators for control of brine circulating systems. **Dampers**—both single and multiple blade, with or without operating diaphragm motors. **Diaphragm Valves**—All metal construction, including three-way valves, brine control valves, etc., etc. **Accessories**—Automatic Water Pan for wet bulb control, Relays, Pressure Reducing Valves, Pneumatic Switches, Dial Thermometers, etc., etc. ***Write for Bulletin No. 251,*** which describes these Instruments.

40 years of specialization in temperature control

Offices in 43 Cities—**Chicago, 2718 Greenview Ave.; New York, 231 E. 46th St.; Toronto, 106 Lombard St.**

OWERS

REGULATOR COMPANY

Degree Days and Unit Fuel Consumption in Typical Cities

May, 1932

UNIT fuel consumption figures given below must be corrected for efficiency, heat content of fuel other than that listed below, for radiation emitting other than 240 B.t.u. per hr., and for radiation calculated on a basis other than zero outside to 70° inside.

Coal is assumed as having a heat content of 12,000 B.t.u. per lb., gas, 1000 B.t.u. per cu. ft., and oil, 140,000 B.t.u. per gal. To correct for other heating values, multiply the fuel consumption listed under the charts by the standard heat content just listed, and divide by the heat content of the fuel actually being used in the installation being calculated.

For radiation installed for any other outside temperature than zero, multiply the fuel consumption given under the charts by 70°, divided by the quantity (70 minus the outside temperature used).

To correct for efficiency, divide the fuel consumption by the efficiency of the heating installation.

For water radiation, multiply the fuel consumption which is given for steam radiation by 5/8.

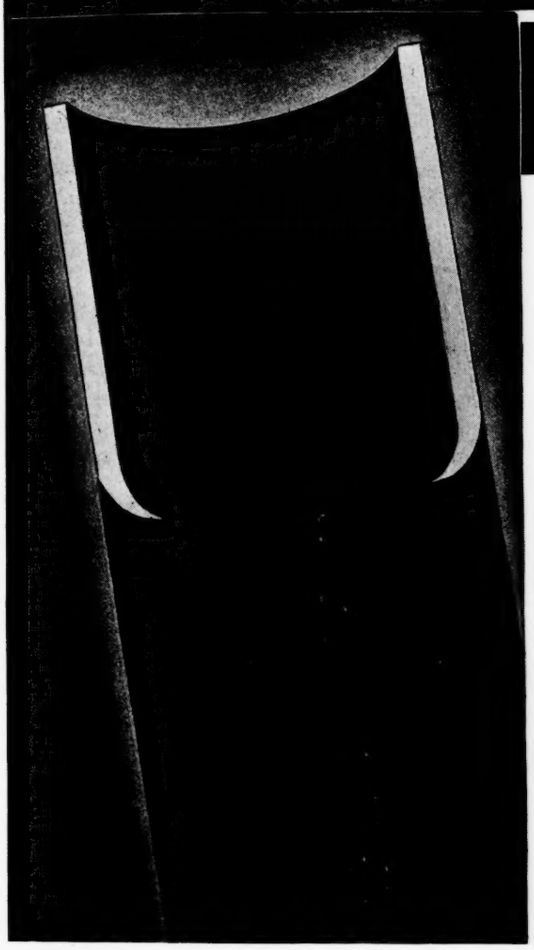
	New York	Seattle	San Francisco	Chicago	Denver	Boston	St. Louis	Pittsburgh	Minneapolis
Degree days	162	318	215	214	193	199	42	165	228
Total degree days since September 1	4414	4762	2894	5243	5606	5093	3581	4566	6943
Lb. of coal per sq. ft. of radiation for May	1.296	2.544	1.720	1.712	1.544	1.592	0.336	1.320	1.824
Gal. of oil per sq. ft. of radiation for May	0.111	0.218	0.147	0.147	0.132	0.136	0.029	0.113	0.156
Cu. ft. of gas per sq. ft. of radiation for May	15.55	30.53	20.64	20.54	18.53	19.10	4.03	15.84	21.89

	Los Angeles	Baltimore	Philadelphia	New Orleans	Atlanta	Cleveland	Cincinnati	Detroit
Degree days	77	102	110	...	39	229	118	209
Total degree days since September 1	1486	3479	3744	656	2165	5004	4076	5411
Lb. of coal per sq. ft. of radiation for May	0.616	0.816	0.880	...	0.312	1.832	0.944	1.672
Gal. of oil per sq. ft. of radiation for May	0.053	0.070	0.075	...	0.027	0.157	0.081	0.143
Cu. ft. of gas per sq. ft. of radiation for May	7.39	9.79	10.56	...	3.74	21.98	11.33	20.06

	Buffalo	Birmingham	Indianapolis	Memphis	Des Moines	Kansas City	Louisville	Galveston
Degree days	367	10	138	9	100	60	84	...
Total degree days since September 1	5889	1776	4456	2223	5595	4168	3521	845
Lb. of coal per sq. ft. of radiation for May	2.936	0.080	1.104	0.072	0.800	0.480	0.672	...
Gal. of oil per sq. ft. of radiation for May	0.252	0.007	0.095	0.006	0.069	0.041	0.058	...
Cu. ft. of gas per sq. ft. of radiation for May	35.23	0.96	13.25	0.86	9.60	5.76	8.06	...

Fuel consumption figures must be corrected for local conditions as explained above.

The FIRST STEP TO PIPING ECONOMY



All National Galvanized Pipe is given a special chromate treatment to resist discoloration and prevent white rust. This patented process preserves that smooth, glistening surface or metallic luster characteristic of good galvanizing practice.

Whatever value may be put into your piping system by intelligent planning and good workmanship, its ultimate usefulness will depend largely upon the choice of the pipe. For, if replacements are necessary they will involve more than repetition of the original cost. The first step to piping economy, therefore, is in choosing pipe that will last.

NATIONAL Scale Free Spellerized Pipe (butt-weld sizes ½ to 3-inch) is steel pipe of the highest excellence, from which mill-scale has been removed by special treatment, to minimize corrosion, especially "pitting". Both surfaces, inside and out, have been made clean and smooth, in order that no enemy of good metal may find lodgment there.

Actual, exact observation has revealed that pipe to which the Scale Free and Spellerizing processes have been applied, is far less subject to corrosion and more immune to deterioration, in general, than pipe of less homogeneous material or pipe not scale free.

You adopt the first step in piping economy when you specify NATIONAL Scale Free Pipe—

America's Standard Wrought Pipe

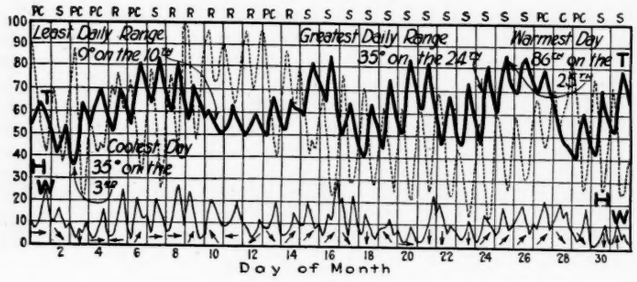
NATIONAL TUBE COMPANY · PITTSBURGH, PA.

Subsidiary of United States Steel Corporation

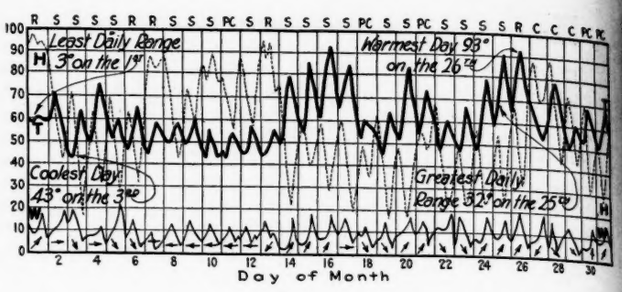
NATIONAL SCALE FREE PIPE
SPELLERIZED

The Weather

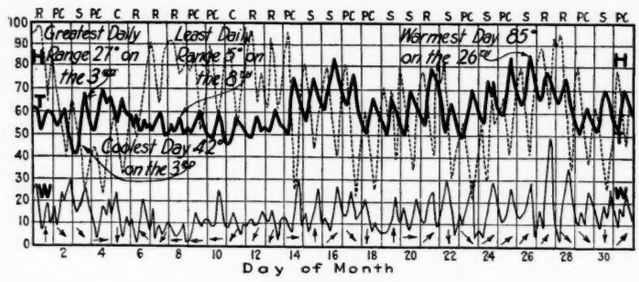
May, 1932


Least Daily Range 9° on the 10th
Greatest Daily Range 35° on the 24th
Warmest Day 86° on the 21st
Coolest Day 35° on the 3rd
Day of Month

Pittsburgh

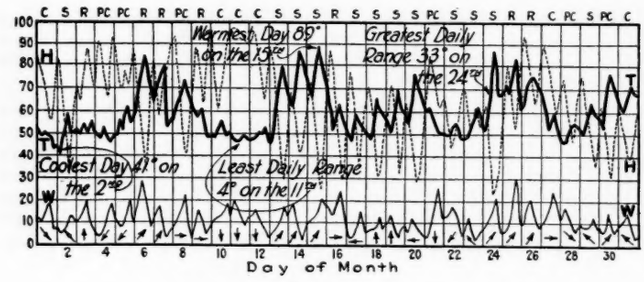

Least Daily Range 3° on the 1st
Warmest Day 93° on the 26th
Coolest Day 43° on the 3rd
Greatest Daily Range 32° on the 25th
Day of Month

Boston

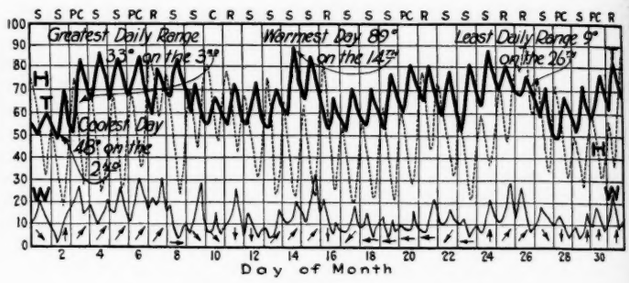

Greatest Daily Range 27° on the 3rd
Least Daily Range 5° on the 8th
Warmest Day 85° on the 26th
Coolest Day 42° on the 3rd
Day of Month

New York

(Hourly observation of the Relative Humidity Plotted on this Chart)


Warmest Day 89° on the 15th
Greatest Daily Range 33° on the 24th
Coolest Day 41° on the 2nd
Least Daily Range 4° on the 11th
Day of Month

Chicago


Greatest Daily Range 33° on the 3rd
Warmest Day 89° on the 14th
Least Daily Range 6° on the 26th
Coolest Day 48° on the 2nd
Day of Month

St. Louis

	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, deg. F.	85	93	86	89	89
Date of highest temperature	26	26	25	15	14
Lowest temperature, deg. F.	42	43	35	41	48
Date of lowest temperature	3	3	3	2	2
Greatest daily range, deg. F.	27	32	35	33	33
Date of greatest daily range	3	25	24	24	3
Least daily range, deg. F.	5	3	9	4	9
Date of least daily range	8	1	10	11	26
Mean temperature for month, deg. F.	60.9	60.2	61.6	59.6	68.0
Normal mean temperature for month, deg. F.	60.6	57.1	62.4	57.5	67.0
Total precipitation, this month, inches	1.81	1.63	3.03	2.89	2.09
Total snowfall, this month, inches	None	None	None	None	None
Normal precipitation, this month, inches	3.24	3.18	3.21	3.54	4.34
Total wind movement, this month, miles	9711	6369	6921	8009	8996
Average hourly wind velocity, miles	13.1	8.6	9.3	10.8	12.1
Prevailing direction of wind	S.W.	S.W.	S.W.	S.W.	S.W.
Number of clear days	9	13	9	11	18
Number of partly cloudy days	14	12	10	9	8
Number of cloudy days	8	6	12	11	5
Number of days with precipitation	9	6	10	11	8
Number of days with snowfall	None	None	None	None	None
Snow on ground, at end of month	None	None	None	None	None

Plotted from records especially compiled for HEATING AND VENTILATING by the United States Weather Bureau.
Heavy lines indicate temperatures in degrees F. Light lines indicate wind in miles per hour.
Broken lines indicate humidity in percentage from readings at 8 a. m., 12 m., and 8 p. m.
S—clear, PC—partly cloudy, C—cloudy, R—rain, Sn—snow. Arrows fly with prevailing directions of wind.

Heating and Ventilating

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A. E. Beals

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Charles S. Hilton

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Some Practical Methods of Eliminating Noise
Everett S. Buck

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Air Conditioning and Cooling for Heating Contractors
Walter L. Fleisher

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Heat Generation and Distribution in an Industrial Building
A. T. North

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Making the Rounds with a Service Man—IV
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Rockefeller Center—Air Conditioning the Broadcasting Studios
A. Warren Canney

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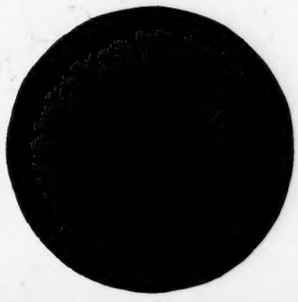
Editorials—Departments—Reviews